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1883	"	63	"	"	1890	"	289	"	"
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THE BERLINER SUIT.

The taking of testimony in the suit of the United States Government to annul the Berliner telephone patent was ended last week, and the record closed, and we have been informed by one of the Government counsel that the case will soon come before the United States Circuit Court at Boston for trial. The suit, besides the interest which its great importance attaches to it, will also probably develop technical features of interest, one of which will doubtless be the question whether a transmitter made under the specific claims of the Berliner patent will really transmit speech.

THE NEW POSTAL TELEGRAPH BUILDING.

The very full description we give elsewhere in this issue of the electrical features of the new Postal Telegraph office building, in which The Electrical World has taken up its abode, will be found interesting as showing among other things what a large part electricity plays in a modern building of this description. The electrical machinery for supplying the current for the electric elevators, for lighting and for telegraphic purposes, though the latter is but a very small fraction of the whole, aggregates no less than 625 h. p., or sufficient to run an express train continuously at a high rate of speed. As a comparison between dynamos for generating electricity for telegraphic purposes and primary batteries, it may be stated that the motor-dynamos that will supply the Postal Telegraph lines with current could be placed in the space occupied by a few hundred gravity cells, and yet they furnish at an insignificant expense and with no regular attendance the current that would otherwise require thousands of cells, occupying an enormous space and at a great cost for chemicals, zincs and care. In addition to the other applications of electricity, there will be electric ventilating fans for summer use, and the desks in different departments of some of the larger offices will be connected by a local telephone circuit, thus obviating the necessity of passing from one room to another when desiring to consult on the numerous questions that arise in the conduct of a large business. With the most extensive and costly offices of any purely technical periodical in the world, located in perhaps the most modern office building in existence, The Electrical World makes a fitting entry upon its twenty-first year, and with its facilities thus extended, ought to still further increase the lead which it has so long maintained in the field of electrical journalism.

RAPID TRANSIT IN BOSTON.

The subject of rapid transit is rapidly coming forward in our larger cities, and of these Boston, after New York, is the one most eagerly seeking a solution to the problem. Three plans have been urged—elevated railways, tunnels, and a subway under one of the most congested streets in connection with elevated roads at the termini. The sacred Commons has interfered with some of the plans that proposed to appropriate a right of way through it, and elevated railways seem to have been discussed largely without reference to the atrocious manner in which they disfigure a city, or the retrograde step in civilization that the toleration of their accompanying din implies. If Boston accepts the elevated railway, then the paragraphs in regard to the worship of John L. Sullivan by its citizens, which were formerly current, can be accepted seriously and as an indication of the changed character of the inhabitants of the Hub. What seems to be by far the best plan offered is one similar to that proposed by the Chamber of Commerce for New York, and, like the sub-

way scheme, involves the use of electricity for motive power. The plan embraces six double tunnels radiating from a central point—equivalent to three separate lines—and extending to a depth below the surface sufficiently far not to affect the foundations of buildings. The stations would be about as far below the surface as the New York elevated stations are above, the down and up grades at each station serving the useful purpose of assisting in gaining momentum when leaving, and losing momentum when arriving at, a station. It is estimated that the lines can be built for $1,500,000 per mile, or all for less than one of the single alley elevated lines proposed. There can be no doubt but that the underground plan, with electricity for motive power, is the only one that offers a permanent solution to the rapid transit question in any city. If the New York Chamber of Commerce rapid transit bill, as modified last week, is passed, as now seems probable, an impetus will be given to the underground system, through furnishing a model for other cities, that will have a far-reaching effect, and also definitely fix the status of electricity as a motive power for rapid transit purposes.

GALVANOMETER SHUNTS.

We print elsewhere in full the paper on "A Universal Shunt Box For Galvanometers," recently read by Prof. Ayrton before the English Institute of Electrical Engineers, with corrections and additions by the authors. The advantage of the form of shunt box described over the usual forms is very apparent, as it not only obviates the accurate division of a shunt resistance in terms of the resistance of the galvanometer, but also reduces errors due to change in temperature. Other advantages are that the same shunt box may be used with different galvanometers, changes in the shunt introduce smaller changes in the resistance of the circuit, and ballistic currents are measured by its means with much greater accuracy than with the old form, though no proof of this is given. To apply the shunt to any galvanometer it would seem from the description that it is only necessary to determine once for all the ratio of the current passing through the galvanometer with any one of the plugs in, and the quantity expressing this ratio may then be combined with the galvanometer constant. This ratio could be determined either by means of another galvanometer, in which case the value of the resistance of neither the galvanometer nor of the shunt box need be known, or by calculation, both these quantities being then known. It is needless to say that this invention marks a real advance in laboratory apparatus, and it seems singular that such a simple and obvious device has not been thought of before.

THE PRACTICAL MAGNETIC UNITS.

One of our contemporaries devotes considerable space to a discussion of the provisional names recently adopted by the American Institute of Electrical Engineers for the C. G. S. magnetic units, and while bestowing approval in some respects,, indulges in some rather remarkable criticism in others. The desirability of concrete names for the units is agreed to, the argument for Greek names is disapproved, and it is acknowledged that so far as the names adopted are simpler than the terms before in use, they are an improvement—which concedes all that is practically at issue. It is argued, however, that instead of following the system adopted in naming the electromagnetic units, and consequently bestowing proper names on the magnetic units, the names of the former with prefixes or affixes—preferably affixes—would have been more appropriate, as "indicating their connection and relation with the former"—that is, with the volt, ampere and ohm! It is left to the ingenuity of the reader, however, to invent the proper affixes, and to determine whether a field of force, for instance, is to be expressed in the terms of the ampere, volt or ohm. The writer dwells upon the necessity of a nomenclature that shall "clearly indicate the inter-relation between the electrical, magnetic and mechanical units, and that inter-relation should be expressible by 10 or powers of 10," and at the same time desires the magnetic units to be directly derived from the electromagnetic ones—as they now are. He might as well ask that π should be given the value of unity with respect to a circle without any change in the fundamental linear unit. π in measurements of the circle and $\frac{1}{4\pi}$ in magnetic measurements are constants of nature, and cannot be thus summarily disposed of. If, for example, our present system of linear measurements were based on π instead of on 10, then, while the ratio of the circumference to the diameter of a circle would become unity, the diameter would have to be expressed in terms of π; similarly, if the practical unit of magnetomotive force, or gilbert, were made equal to an ampere-turn, or unity, as proposed instead of .7958, as objected to, then the reluctivity of air, for example, instead of being unity, would be expressed by $\frac{1}{.7958}$ or 1 2566. While thus practical difficulties would be encountered, the plea of the writer that the magnetic units should be directly derived from the electromagnetic units and their direct inter-relation maintained would also be fruitless, for the constant objected to is, in fact, that which binds the two systems together. Should magnetomotive force be made expressible in ampere-turns, either directly or in powers of 10, then the direct connection of the two systems would be severed, or, if maintained, the constant gotten rid of in the magnetomotive force would have to appear in current, electromotive force or resistance. This follows from the centimetre, gramme and second being equally the basis of both the electromagnetic and magnetic units. If we make a change in the value of the unit of magnetomotive force derived from these, that implies a change in one of these fundamental units; if the unit of magnetomotive force is to be expressed by unity, it will be seen, bearing in mind the B. A. definition of current, that the dyne must be reduced from unity to $\frac{1}{4\pi}$, and, therefore, either the centimetre or gramme would be changed in the same ratio if the units in the two systems are to remain directly related, and consequently the present values of the unit of electromotive force, current or resistance would also be changed. Were these difficulties not present, any change in the magnitude of units, it may be here remarked, would not have been within the province of the Institute. The action of that body was not, as seems to be supposed by some, the adoption of a new system of units, but merely consisted in giving names to the present C. G. S. magnetic units. As these same units were already in universal use as practical units, for we need not count the absurd "Kapp lines," no change was made beyond giving them concrete names. The ampere-turn is not displaced nor affected in any way, for the gilbert, though then nameless, was used in all previous operations involving magnetizing force—that is, ampere-turns.

Patent Litigation.

Judge Coxe, of the United States Circuit Court, on Monday, April 9, heard the arguments of the General Electric Company for a preliminary injunction against the F. P. Little Electrical Company, of Buffalo, N. Y., and the E. G. Bernard Company, of Troy, N. Y., for alleged infringement of various patents, as follows:

Patents on compound winding, the three-wire system, coupling dynamos (two), lamp sockets, multiple arc system, double-pole safety catch, and safety catches with special ends and porcelain bases. The above eight patents were in both

bills, and in addition a patent on the use on the same circuit of incandescent lamps of different candle power in that of the E. G. Bernard Company, and one on coupling compound dynamos in parallel in that of the F. P. Little company. Counsel for the General Electric Company asked permission, which was granted, to withdraw the patents on the three-wire and multiple arc systems, double-pole safety catch, coupling compound dynamos in parallel, and the one relating to incandescent lamp sockets, which is the same that was recently declared void by Judge Coxe, in the suit of the Syracuse Electrical Engineering and Supply Company.

The court sustained the demurrer of the counsel of the E. G. Bernard Company on the ground of multifariousness of the bill of complaint, and dismissed the motion for a preliminary injunction with leave to use the papers heretofore served, when amended, in any new motion for an injunction, if one is made.

In the case of the F. P. Little company, the court refused to consider the motion for a preliminary injunction on the ground that it involved the consideration of questions of fact, which should not be determined on affidavits but postponed for proper consideration on final hearing. The defendant filed a bond of $5,000 and the case was put over for final hearing.

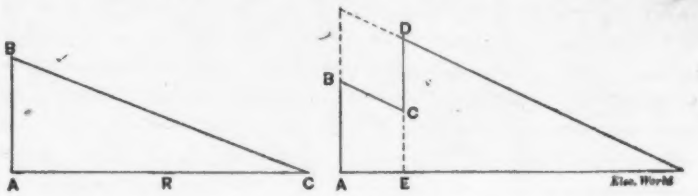
Unipolar Induction and Current without Difference of Potential.—II.

BY A. G. WEBSTER.

CURRENT WITHOUT DIFFERENCE OF POTENTIAL.

This is another frequent stumbling block. In the issue of Feb. 17 Mr. Philip K. Stern falls foul of the typical example given by Prof. Anthony, propounds a theory involving strains in the luminiferous ether, and winds up with the request to be kindly informed if a current flows in a ring without difference of potential, which way it may be expected to flow. This depends on which pole of the magnet is thrust into the ring. Prof. Anthony might retort by asking, if there is a difference of potential, at which point of the ring it may be expected to be the highest. I suppose there is no question that a current would flow in the ring. The trouble in the matter generally proceeds from a misapprehension of what potential and electromotive force really are. Difference of potential implies a disturbance of the distribution of charge from the state of equilibrium, requiring work to produce it, but not to maintain it. In order to maintain it a counterbalancing electromotive force is necessary; otherwise the charges will flow back, causing a current. Now an electromotive force may act continuously with or without a difference of potential. Ohm's law tells us that the current in a conductor between two points is proportional to the electromotive force in the conductor between them plus the difference of potential, or "drop," between them. If the electromotive force is equal and opposite to the drop, there will be no current. If, on the other hand, there is an equal electromotive force generated in every unit of length all around the circuit, there will be no difference of potential. The case of the ring mentioned is an example. A symmetrical solenoid closed on itself with a magnet thrust into it, or with another solenoid forming a transformer, is another.

Perhaps the subject is made simpler where the electromotive force is not due to induction, and is not continuous in the conductor. Consider a single cell of a battery. If we represent the potential of different points in the circuit as ordinates to abscissas representing resistances measured from a fixed point of the circuit, we get a straight line whose slope represents the strength of the current. At some point in the cell the potential rises abruptly by the amount *A B* Fig. 9. Consider now two cells, each of half the former electromotive force, the whole resistance of the circuit being the same as before. The current is the same as before, but the greatest difference of potential between any two points is now represented by *E D*, Fig. 10, and is less than before Consider now any number of cells, say six, each of one-sixth the original electromotive force, connected in a ring,



FIGS. 9 AND 10.

without external resistance, the total resistance being still the same. The current is the same as before, but the maximum difference of potential between two points is only *A B* Fig. 11, one-sixth as much as at first. Consider now a great many cells so connected, the total electromotive force and resistance being the same, hence the current also, while the difference of potential between any two points is extremely small, and in the limit zero. Thus we see how, when the

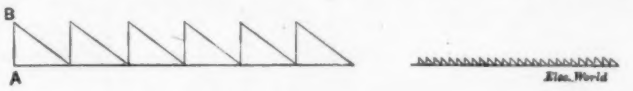


FIG. 11.

electromotive force is continuously distributed, we may have a current as large as we please, without difference of potential. In all the figures the oblique lines are intended to have the same slope.

In the issue of Feb. 24 Mr. Oliver B. Finn describes a pretty experiment with an oil can and an electrical belt (not of Harness'), and he also propounds a theory, involving ether vortices this time. I am beginning to regret that Prof. Lodge ever wrote that book. If Mr. Finn will take the trouble to calculate the magnetic effect of a moving charge, bearing in mind the size of the ratio between the electrostatic and electromagnetic units, he will get some idea of the inadequacy of his explanation. The same remark applies to Prof. Elihu Thomson's recent theory of terrestrial magnetism. For although the effect of a charge in motion is the same as that of a current, and although, as Hertz has shown, moving magnetism or varying electromagnets produce electrostatic effects, the magnitude of such effects is so small that they have never been observed except by Rowland, in his classical experiment, and in a similar one by Rontgen. The exact symmetry, by the way, between the electromagnetic and magneto-electric equations, as brought out by Hertz, and unfortunately a good deal disguised in Maxwell, is a good reason for preferring Hertz's equations to Maxwell's.

The writer, like many others, has difficulty in remembering the relative directions of magnetic force, current and motion. He finds the following rule convenient. It is only necessary to remember the direction of linking of current and line of force. The positive directions in the two links are taken as the directions of rotation of the hands of a watch standing before you and lying on its back, respectively. Either link represents the current and the other the line of force produced by it. Unlinking induces a positive current. This gives us the following two rules for motor and dynamo. The right hand gives us the directions for motor, the left for dynamo. Forefinger gives magnetic Force, Middle finger direction of Motion, thumb current in motor, or electromotive force in dynamo.

(In replying to the first part of Mr. Webster's article, I regret that I cannot agree with him that he has "effectually disposed of the question whether the field of a symmetrical magnet rotates with it or not." The question whether the

lines or tubes of force rotate with the generating coil or with the iron core (which, I suppose, is what he meant in the above quotation) still remains unanswered. All that he has shown is that theoretically it appears to make no difference what the answer to this question is, a point which I, for my part, never disputed. Practically, however, that is, in the actual construction of a machine, it may make a very great difference. As the principal obstacle in the construction of a unipolar machine lies in a practical difficulty, namely, in the necessity of having a large number of sliding contacts, this question might be of considerable importance in the actual construction of a machine, even though theoretically it might not affect the results.

I must differ with him very decidedly in his rather brusque statement that this question is "devoid of sense," for, aside from the reasons given above, I cannot agree with him that it is ever "devoid of sense" to try to understand a phenomenon or experiment thoroughly in all its details. In this very subject of unipolar machines it has generally been a want of a thorough understanding that has led many to construct inoperative machines.

The question at issue, if it is of interest to any one, could be decided very easily by constructing a crude unipolar machine of a disc in front of an electromagnet by revolving the disc, first, with the whole magnet at rest; second, with the core revolving with the disc, the coil remaining at rest, and, third, with the coil revolving with the disc and the core remaining at rest. If the E. M. F. between the centre and the circumference of the disc be measured in each case, it seems to me the question could be settled.—Carl Hering.)

British Association.

At the coming meeting of the British Association, at Oxford, Prof. A. W. Rucker will preside in section A (Mathematics and Physics), and Prof. Kennedy in section G (Mechanical Science). Sir Douglas Galton will be proposed as president for the meeting in 1895, which will be held at Ipswich.

Analogies and Differences Between Magnetic and Electric Quantities.

BY CARL HERING.

Students and beginners may find some assistance in the following tabulated summary. Although the analogies are not perfect, yet they are at least sufficiently so to assist one in obtaining a good general idea of most of the magnetic quantities:

ANALOGIES.

MAGNETIC.				ELECTRIC.			
Quantity.	Symbol.	Practical and C. G. S. unit.	Formula.	Quantity.	Symbol.	Practical unit.	Formula.
Magnetomotive force	$\mathfrak{F}$	gilbert †	$\mathfrak{F} = \frac{4\pi}{10} A\,t$ *	Electromotive force	E, e	volt	$E = \frac{\Phi}{10^8 T}$ *
Magnetizing force	$\mathfrak{H}$	gauss‡	$\mathfrak{H} = \frac{4\pi A\,t}{10 L}$	(No analogy)	.....	.....	.....
Reluctance	$\mathfrak{R}$	oersted	$\mathfrak{R} = \frac{L}{S} \nu$	Resistance	R, r	ohms	$R \quad \frac{L}{S} \rho$
Flux	Φ	weber	$\Phi = \frac{\mathfrak{F}}{\mathfrak{R}} = \mathfrak{H} S$	Current	C, c	ampere	$C = \frac{E}{R}$
(No analogy)	.....	.....	.....	Quantity	Q, q	coulomb (ampere hour)	$Q = C T$
Reluctivity or specific reluctance (air = unity)	ν	.....	$\nu = \frac{1}{\mu}$	Resistivity or specific resistance	ρ	.....	$\rho = \frac{R S}{L} = \frac{1}{\gamma}$
(Not used)	.....	.....	.....	Conductance (popularly called conductivity)	G, g	mho	$G = \frac{S}{L} \gamma = \frac{1}{R}$
Permeability (air = unity)	μ	.....	$\mu = \frac{1}{\nu} = \frac{\mathfrak{B}}{\mathfrak{H}}$	Conductivity or specific conductance (popularly called specific conductivity)	γ	.....	$\gamma = \frac{1}{\rho}$
Field intensity and Magnetic induction.	$\mathfrak{H}$	gauss	$\mathfrak{H} = \frac{\Phi}{S}$	Current density	.....	amperes per unit of cross section	$\frac{C}{S}$
	$\mathfrak{B}$	gauss	$\mathfrak{B} = \mu \mathfrak{H}$				
Magnetic law	—	—	$\Phi = \frac{\mathfrak{F}}{\mathfrak{R}}$	Ohm's law	.....	.....	$C = \frac{E}{R}$

A t = number of ampere-turns in a coil; S = surface or cross-section in square centimetres; L = length in centimetres; T = time in seconds. With the exception of C for current, all the symbols used are those recommended by the recent International Congress (see The Electrical World, Sept. 23, 1893), in which I and i are used in place of C and c for current. The practical magnetic units are the same as the C. G. S units.

* These two formulas form the connecting links between the two systems.

† Ampere-turns are used more frequently as the practical unit, but an ampere-turn is not numerically equal to the C. G. S. unit or gilbert; 1 ampere-turn = 1.25664 gilbert or C. G. S. unit; 1 gilbert or C. G. S. unit = .795775 ampere-turns.

‡ Magnetizing force is more frequently measured in ampere-turns per centimetre of length.

DIFFERENCES.

The two important differences between the two systems are:

(1) That the specific electric resistance of the usual materials is very nearly constant (varying only slightly with the temperature), while the specific magnetic reluctance varies very greatly with the flux density.

(2) That, as a magnetic circuit cannot be "insulated" magnetically, it is similar to an electric circuit which "leaks" very much; that is, to an electric circuit placed, say, in a poorly conducting liquid whose specific resistance is from several hundred to several thousand times as great as that of the magnetic circuit.

A Good Advertisement for Lightning Rods.

Abraham Lincoln, in a political speech, is reported to have said that a certain political opponent had felt obliged to erect a lightning rod over his house to protect a guilty conscience against an offended God. Soon after this the lightning rod business boomed all over the country.

THE POSTAL TELEGRAPH-CABLE COMPANY'S NEW BUILDING

ELEC. WORLD, N.Y

The most striking feature of lower New York to-day is the tendency towards magnificent office buildings, as evidenced by the lofty structures which are now springing up on every side. There seems to be a common desire for more ambitious quarters, and the modest buildings which a few years ago were thought to be quite sufficient for the needs of New York business firms are rapidly being replaced by structures of a radically different type. The tendency is decidedly in the direction of high buildings, the natural result of the appreciation of real estate in this section of the city. This tendency heavenward, if it may so be called, while certainly commendable, is capable of abuse, and in some buildings has resulted in the sacrifice of all the finer qualities of architecture in the gratification of this ambition.

Of the more recent additions to the long list of new buildings, the home of the Postal Telegraph-Cable Company, on the corner of Broadway and Murray street, is one of the most attractive and pleasing. Although an immense structure, covering a large area and reaching up fourteen stories in height, the architects, Messrs. George Edward Harding and Gooch, have avoided any appearance of unnatural height and have happily blended grace of design with a sense of solidity. While the architectural details are beyond the scope of this article, we cannot fail to note the admirable manner in which the plans of the architects provided for the installation of the electrical circuits by means of accessible runways in the masonry and partitions. Notwithstanding the great part which electricity now plays in modern buildings, it is too often the case that no rational provision is made for this purpose, and it is therefore with pleasure that we call attention in this respect to the work of the architects of the Postal Building, the senior member of which is a brother of H. McL. Harding, so well known in the electrical field as Eastern representative of the Walker Mfg. Co., and who, by the way, has taken an office in the building.

Principal Stockholder.

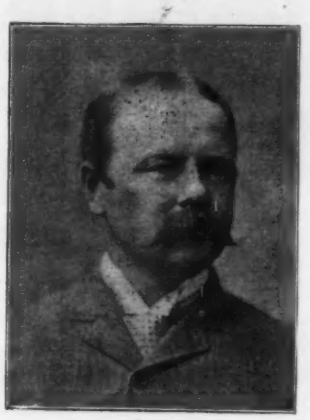
President.

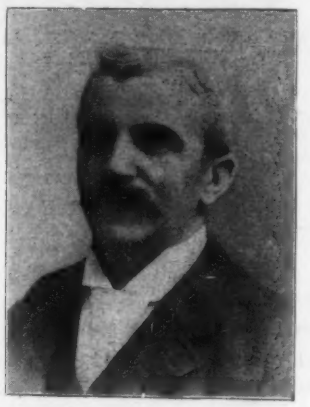
While familiarly spoken of as the Postal Telegraph Building, it is really the property of the California millionaire, Mr. J. W. Mackay, president of the Commercial Cable Company, and chief stockholder in the Postal company, the two companies being lessees of the property. The father of the enterprise may justly be said to be Mr. A. B. Chandler, president of the Postal company, whose conception it was and through whose untiring efforts it has finally been carried out. Too much praise cannot be accorded the building committee, consisting of Mr. W. H. Baker, vice-president, and Mr. E. C. Platt, treasurer of the Postal company, and Mr. Geo. G. Ward, vice-president and general manager of the Commercial Cable Company, who are responsible in a large measure for the suc-

VIEW OF THE BUILDING FROM CITY HALL PARK.

cessful completion of the work. It was long ago seen by the president and officials of the Postal company that more commodious and convenient quarters were necessary, and the selection of the present site was a most judicious one. It is situated at about the center of the downtown business interests, is near the newspaper offices and accessible by all the elevated lines, cable and horse cars, ferries and the Brooklyn Bridge. Facing on City Hall Park, and occupying a corner, a pleasant prospect and an abundant supply of light and air are assured. From the rear windows of the upper stories a magnificent view of the North River is also afforded. The accompanying illustration gives an excellent idea of the general appearance of the building and some of the beautiful architectural details.

Vice President and Treasurer of the Postal Company.





Architect and Electrical Contractor of the Building.

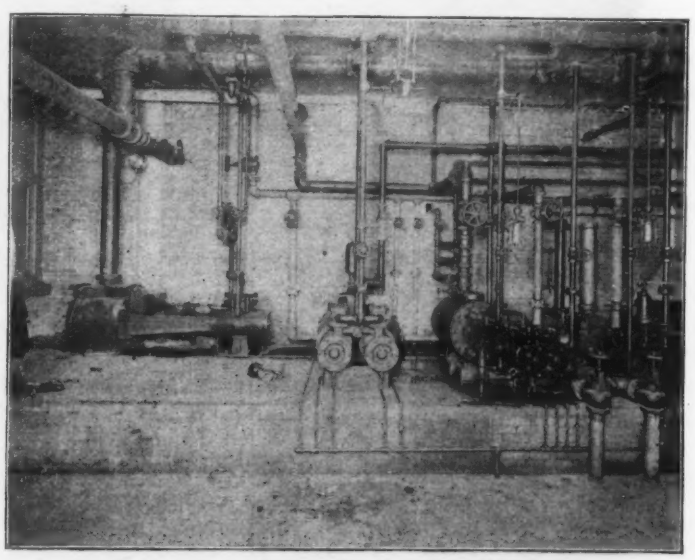
The building has a frontage of 70 feet on Broadway and 156 feet on Murray street, with an L of 30 by 50 feet at the rear. The height of the building is fourteen stories. The frame is of steel and the walls are of Indiana limestone to the fifth story, gray brick being used above this, with appropriate trimmings. The interior is in keeping with the exterior, and is handsomely finished throughout, the woodwork being birch. The floors are of cement tiles.

In the commodious sub-basement are located the dynamo, engine and elevator plant, the boiler room being in an extension. The basement is used for the supply department of the Postal company and for storage. The first or ground floor contains the receiving and delivery departments of the company, most conveniently arranged and handsomely finished. Marble is exclusively used on this floor with very beautiful effects. The marble staircase is of exceptional merit. The second floor will be occupied by a bank or corporation, the third by The Electrical World and private offices, and the remaining floors, with the exception of the eleventh, twelfth and thirteenth, which will be used by the company, are given up to offices. The Hardware Club has beautiful quarters on the top floor.

From an electrical standpoint, the building is of unusual interest, for it is perhaps the most thoroughly and perfectly equipped of any in the country. In addition to a telegraph installation of the most modern type, including a motor-dynamo plant to feed the lines, there is a lighting plant of 3,500-lamp capacity and a power plant to operate the six electric elevators with which the building is equipped.

The steam plant is located in the annex to the sub-basement, and as might have been anticipated in a building of this character, consists of the well-known Babcock & Wilcox boilers. The boilers are arranged in batteries of two, it being expected to hold one battery as a reserve. Two of the batteries are of 225 h. p., consisting of 18-foot sectional boilers, with 130 tubes, and a 30-inch steam drum. The third battery is of 275 h. p., the boilers having 150 tubes, the length and diameter of drum being the same. The boiler room, as may seen from the cut, is conveniently but compactly arranged. The ventilation is excellent, and it should prove a comfortable place even in summer. The Locke damper regulator is used

THE BOILER ROOM.



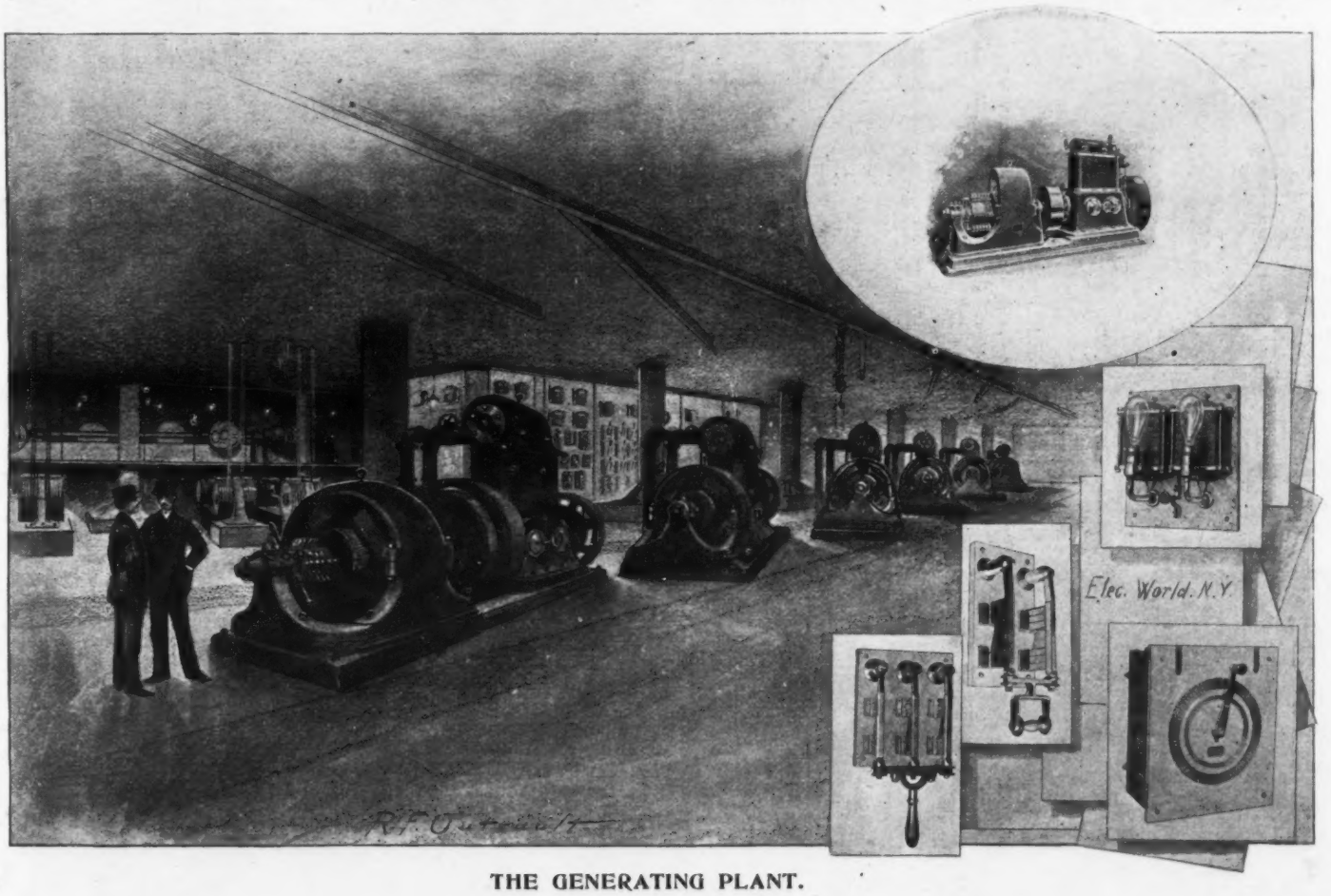
THE PUMP ROOM.

with excellent results, keeping the pressure constant within a variation of one pound. Many of the steam accessories were installed by John Acton, including a 14-inch back pressure valve, which operates, it is claimed, perfectly noiselessly; a 6-inch reducing valve on the heating main, where the pressure is only 2 pounds, and an exceedingly sensitive valve is required, and a 1 1-2-inch high pressure valve. The steam piping is carried from the boiler beneath the floor, adding much to the appearance of the boiler and engine room. A pressure of 110 pounds will be used.

The pumping room equipment consists of one 7 1-2 X 4 1-2 X 10 Worthington duplex boiler feed pump, two 6 X 4 X 6 Worthington duplex sanitary and house service pumps, and one 6 X 4 X 6 Worthington automatic feed pump and receiver. The arrangement of the house and sanitary supply is on the pressure system; that is, an enclosed cylindrical tank of 2,350 gallons capacity, supplied by two 6 X 4 X 6 pumps, having three separate and independent suctions, one from Warren street, one from Broadway, and an auxiliary suction tank of 2,000 gallons beneath the floor. Water is pumped direct into the tank, which is supplied with air through the suction of the pump and maintained on the quarter line of the tank—a pressure of 120 pounds being constantly maintained and regulated automatically. An enclosed cylindrical tank for hot water of 420 gallons capacity takes its supply through a direct connection with the cold water tank, with a check valve to prevent back pressure. The temperature is controlled by a thermostat valve, which operates at 150 degrees, and the water is heated by a steam coil in the tank. All the returns from the steam heating drips, etc., gravitate to the Worthington automatic feed pump and receiver, and are automatically returned to the boiler, the pump being of ample size when running light to feed 720-h. p. boilers. All connections are made in duplicate, so that in case of fracture shutting down of the water supply is obviated.

Three steam elevators have been installed by the Adams & Cartwright Elevator Company. One of these is a worm-gear and screw-steam elevator, located in the light shaft and running to the roof, a distance of 200 feet. This machine lifts a live load of 2,000 pounds at a speed of 200 feet per minute. The other two machines are steam sidewalk elevators, travelling from the sub-basement to the sidewalk, with a capacity of 3,000 pounds each.

From the accompanying illustration, a general idea of the arrangement of the dynamos and engines, as well as of the type of machines used, can be obtained. There are at present five units, but provision has been made for a sixth, as shown, when it may be needed. The engines are of the Westinghouse vertical compound type, the two in the foreground of the illustration being of 160 h. p. and running at 240 revolutions, while the others are of 100 h. p. and run at 50 revolutions per minute faster. The foundation is of solid concrete, 8 feet deep by 20 feet wide, and running the entire length of the room and entirely isolated from the floor, so that it is thought that the vibration of the machinery will not be perceptible in any part of the building. It will be noticed that the machines are set diagonally, this being found necessary in order to give them an isolated foundation and get them into the required space, and the plant is consequently very compact.



THE GENERATING PLANT.

The generators are of the Westinghouse 4-pole railway type and are direct connected. Four springs connect the two sides of the coupling, permitting, it is claimed, a maximum extension of 9 inches, thus making provision for the greatest possible variation in load without injury to either machine. The couplings are well insulated with fibre. The two generators connected to the larger engines are of 120-kw. capacity, and furnish current at a pressure of 240 volts to supply the elevators. One is sufficient for this purpose, and they will probably run alternately, with one as a reserve.

The other generators are of 75-kw. capacity, and constitute the lighting plant, one of them also being used to feed the motor-dynamo of the Postal plant. A terminal board

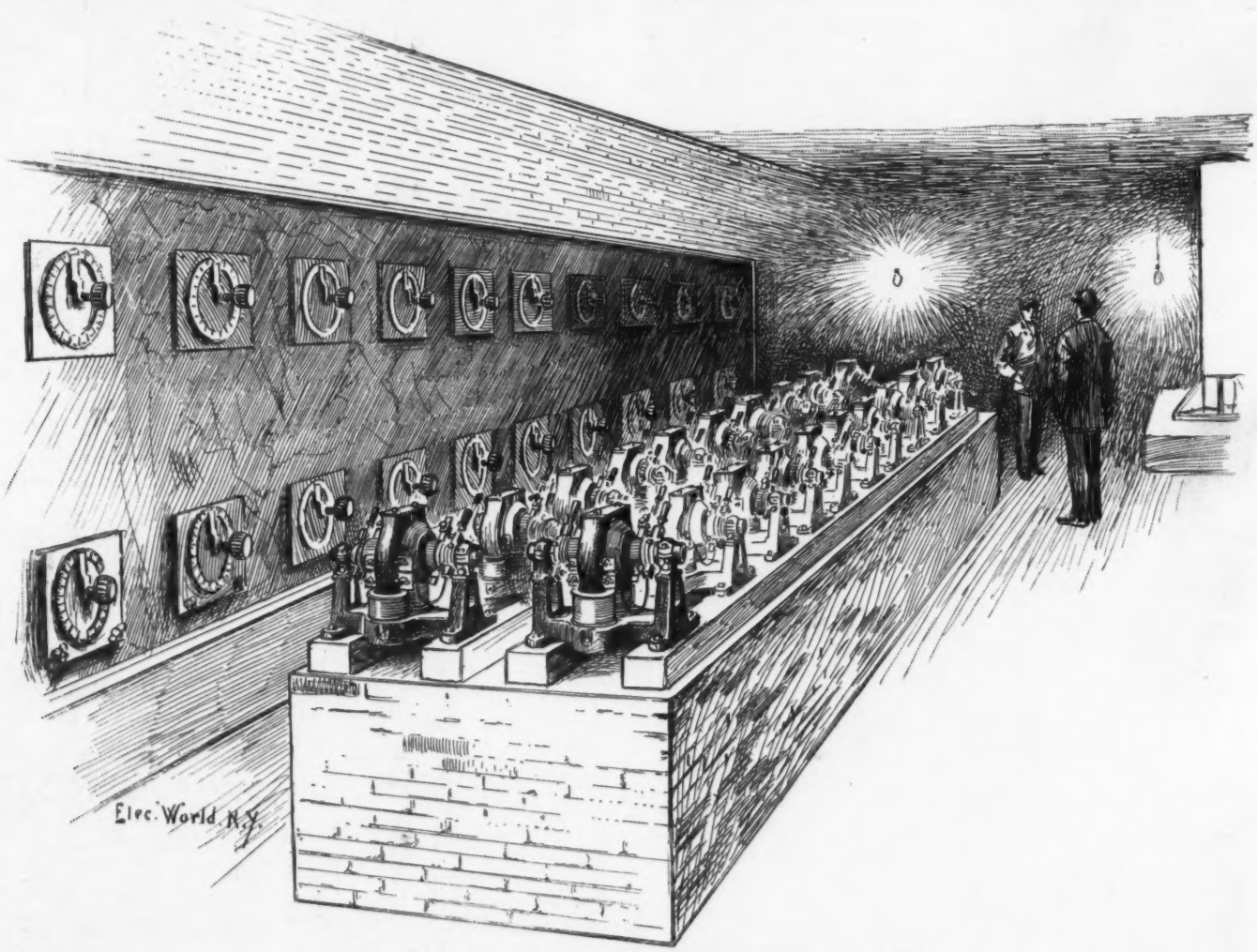
on one side of the field yoke contains the connections for the field winding and main leads, and on the other side is a cut-out switch. Eight 0000 stranded lead-covered cables run through iron ducts beneath the floor, giving practically no drop between the machine and the switchboard. At the rear of the machines is a trench for the equalizing mains, and the terminals are run to separate bus bars on the rear wall. There are two equalizing boards, one for the power and one for the lighting machines.

Much credit is due to the Westinghouse Electric and Manufacturing Company for the excellent plant which it has installed, and to Mr. Edward W. Seymour, who has so ably superintended its design and erection.

The dynamos and engines occupy the whole south side of the room, which is approximately 100 feet square. In the northeast corner is a most interesting plant of the Postal company, shown below. It consists of 20 Crocker-Wheeler motor-dynamos, or continuous current transformers, arranged as shown, and of varying sizes and voltages. The potential of the different machines varies, the lowest being 40 volts, the highest 350, with 85, 130 and 200 as intermediate voltages. There are two machines for each potential, one positive and one negative, and each machine is entirely independent of the other. They are driven as motors from the lighting circuit and individually controlled from a panel of the main switchboard. On the wall at the rear are rheostats for each machine. A special switchboard, not shown in the illustration, but situated just to the left of the plant, controls the dynamo circuits of these machines. The advantages of such a plant are very marked, and its introduction is one of the most important advances made in telegraph work in recent years. These machines replace an almost countless number of cells, occupying only a fraction of the space required by the batteries, performing the work more satisfactorily and requiring much less attention.

In the opposite corner, on the north side of the dynamo-room, is located what may perhaps be regarded the most interesting feature of the electrical equipment of the building, on account of its novelty—the Sprague-Pratt electric elevator plant. The introduction of electric elevators in a plant of this magnitude was an important step and its career will be watched with great interest on account of the effect it will have on the elevator industry in the future.

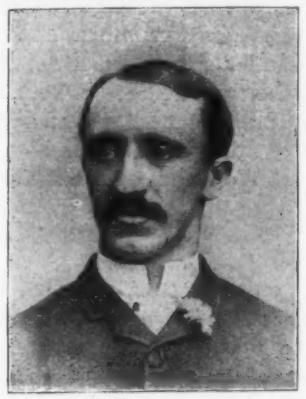
The elevators are divided into three groups, or pairs, two sets being "way" elevators, stopping at all floors, excepting the twelfth and thirteenth, and arranged with one general frontage, a gangway in the middle and the main stairs winding around one set. The remaining set constitutes the "express" elevators, and stops only at and above the eleventh floor, being practically private elevators for the Postal Telegraph and Commercial Cable offices, operating room and restaurant. This set is placed in the rear of one pair of way elevators and separated from them by the main stairs. All cars have independent platforms fitted with centrifugal governors set to be operated at 600 feet car speed by standing ropes. The car finishes are of ornamental bronze of the usual type. The "way" cars are a fifth larger than the express and have four hoisting and two counter-weight ropes, while the latter have two less hoisting ropes. The required loads are directly and the speeds inversely proportional to the floor areas, those for the "way" cars being 2,400 pounds live load at 325 feet, and for the express cars, 2,000 pounds at about 400 feet. The speeds running light are about 10 per cent. higher. These are the present normal speeds, but the motors have been found to be of so abundant capacity that the speeds can be increased to 450 feet for the "way" and



THE POSTAL TELEGRAPH MOTOR-TRANSFORMERS.

from 575 to 600 feet for the "express" without difficulty or straining.

The shaft and overhead work is identically the same as in first-class hydraulic plants and variable chain counter-weights are used to make the pull equal at all points of the hoistway for any given carload. The lower landing is at the street level, with pit extending into the basement. The hoisting



Inventors of the Sprague-Pratt Elevator.

ropes lead directly to the outboard sheaves of the hoisting machines in the sub-basement and dividing on either side of the crosshead, pass around the sheaves, 10 geared for the "way" and 12 geared for the express, and are anchored to the heads of the machines.

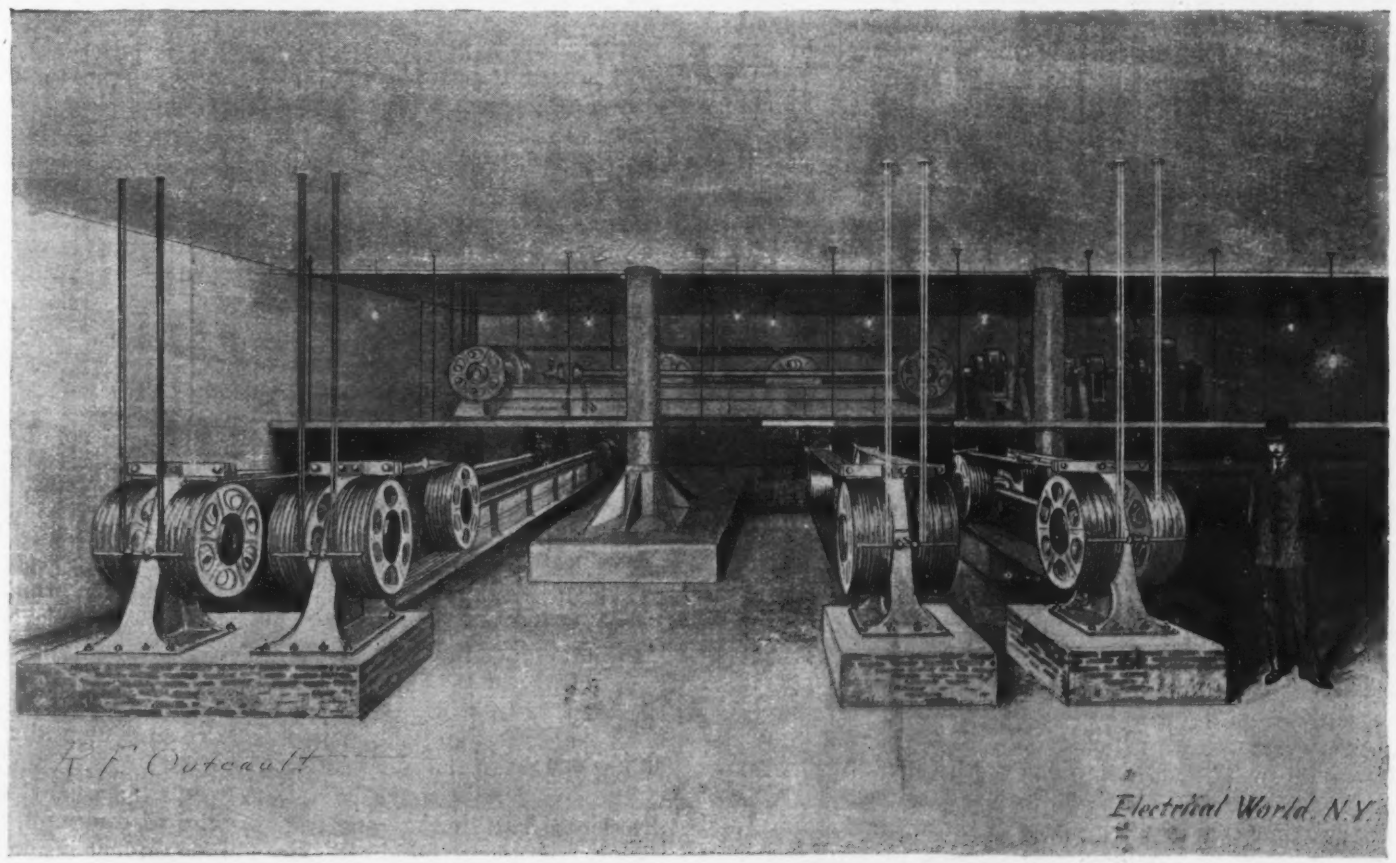
So far, with the exception of the control, the practice is that of the horizontal hydraulic elevator.

the cars the position of the foundations and the party wall, six machines, two at right angles and above the other two, are placed in a space about 30 feet square, with ample room for at least eight more machines, all self-contained, each perfectly independent, and with every facility of access.

Briefly described, the machine is of the horizontal multiple sheave type with a travelling crosshead and frictionless ball nut driven by a screw revolved by a motor directly connected and governed by a pilot motor and rheostat.

The elevation on the next page will show the general mechanical construction. This consists of a heavy main beam carrying the travelling crosshead and lower screw bearing, with special castings bolted at each end, one carrying the fixed set of sheaves and the other the thrust bearing, brake and motor. The regulating apparatus is independent and self-contained, and is placed on the wall. From the car to the system of multiplying sheaves this machine and the horizontal hydraulic elevator are practically the same. The crosshead, however, marks the point of departure in the two types, and this is the one at which the troubles of the hydraulic elevator begin, and from which the Sprague-Pratt electric elevator marks its evolution in elevator practice.

In the hydraulic machine this crosshead is rigidly attached to the end of a rod terminating in a piston moving in a cylinder having an inside length equal to the lineal movement of the crosshead. This cylinder in the vertical type of hydraulics varies from 30 to 45 feet in length, with from two to eight sheave multiplications, and in the horizontal types the multiplication runs as high as 12 with corresponding diminution of length of cylinder and increase in cross section. Whatever the gearing, however, the length of cylinder is a function of the car travel. In this electric elevator, the crosshead being moved along a screw stationary so far as lineal movement is concerned, there is, with any given number of



GENERAL VIEW OF THE ELECTRIC ELEVATOR PLANT.

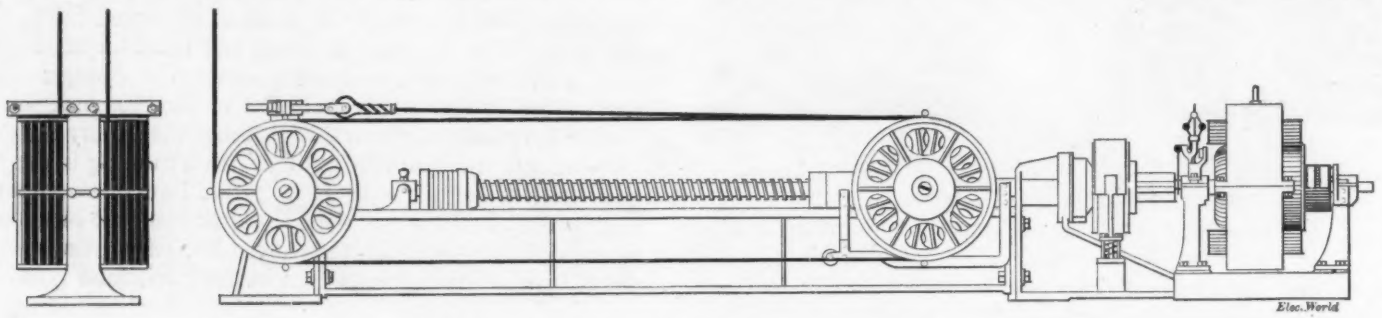
Coming now to the machines in the basement, the distinguishing features of the electric plant become pronounced, and first, and by no means the least important, is the space occupied, for here, on account of the peculiar disposition of sheaves, only one variable, the length of screw, and for all heights above about 90 feet, the electric machine has an advantage in matter of length which with increased rises becomes of great importance.

Turning now to the operation of this machine, there are four features claiming special attention. These are the nut, screw and bearing, the brake, the motor and the regulating apparatus.

The hoisting nut being the first step in order, its connection with the travelling sheaves is the first thing to consider. It will be seen that it joins the crosshead of the travelling sheaves by a conical seat. There is no fastening between the nut and the crosshead, the continual weight of the car always keeping them in contact, and the friction at this point being greater than between the nut and the screw enables the latter to transmit a straight line movement to the crosshead when the screw is revolved by the motor, and also to revolve the screw and drive the motor as a dynamo when the mechanical brake releases the screw to allow the car to descend.

To continue the line of transmission of power, it will be with a peculiarly shaped thread. It passes through the clearance hole in the steel trunnion crosshead which carries the travelling sheaves, then through the nut system, and is carried at the outer end by a pivoted bearing. At the other end it terminates in the thrust bearing, where the pressure is taken by about 220 steel balls carried in a bronze guide plate and bearing on specially hardened steel discs. The thrust of the screw being thus taken up on the inboard end, the strain on the screw is invariably between that end and the travelling crosshead, never beyond this; hence, it is always under extension strain, never under compression. Beyond the thrust plates is keyed a radially lagged iron and wooden pulley connected by a flexible coupling with the motor shaft.

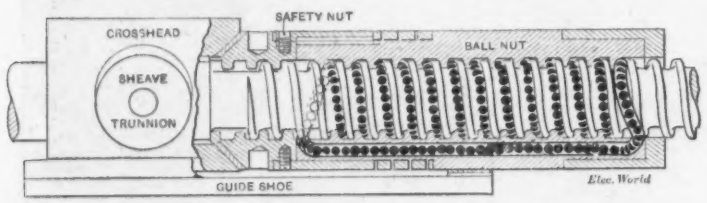
The function of the brake is that of locking the screw when at rest, and is not a means of varying the speed. In case of accident it has the additional function of helping to stop the screw. It may be described as a compound electro-



ELEVATION OF ELECTRIC ELEVATOR.

seen by the cut that the only points of contact between the nut and screw are by a chain of balls, which occupy twelve threads, and are shown entering and leaving the ends of the nut through a tube, which takes the balls as they leave one end and returns them to the other end at a tangent to the line of travel between the threads of nut and screw. This is one of the most vital points of the elevator apparatus, and herein lies one of the most potent reasons of its success—the reduction of friction by rolling instead of sliding surfaces on almost all parts under pressure—for not only is the nut so constituted, being, in fact, a developed spiral thrust bearing, but the thrust bearing at the motor end of the screw is taken on balls and the sheaves are carried on ball or roller bearings.

So free is this machine from static friction that it is pos-



SECTIONAL VIEW OF BALL NUT.

sible to start the car with a slight increase of current over the normal hoisting current, provided time be taken so that the work done in acceleration is small compared to the work of lifting.

A test was recently made on a Fairbanks testing machine in New York to determine the liability of balls crushing under normal or extra working strain. Ten balls of two different makes were put under crushing strains, and required from 20,000 to 40,000 pounds to break each of them. The working pressure varies from 50 to 125 pounds per ball.

The nut system is a compound one, for besides the working ball nut there is another, called the safety nut, keyed to it, and between the two is a powerful spring under compression.

The screw is a specially forged bar of high carbon steel

mechanical brake. The brake band, of steel and leather lined, is anchored at one end, the hoisting side, on the motor bed frame, and the other end is continually pulled down by a powerful spring under compression. The mechanical movement in opposition is through the medium of a lever fulcrumed on a peculiar magnet casting and having at its short arm end a universal socket connection to the divided core of a closed circuit steel magnet. This core has a movement of one-eighth of an inch, and with the expenditure of a quarter of a horse power of electric energy has a pull of nearly three-quarters of a ton. It is operated by a dual circuit, one in hoisting, another in lowering, each possessing pecularities in its action. In the event of failure of current for any reason or too high a speed on the down run this magnet releases the brake, in the latter case by a snap switch operated by a Pickering centrifugal governor driven by the main screw, and the brake band promptly grips the brake wheel softly, yet powerfully.

The motor is of the 4-pole type, two poles being consequent, and the winding is strongly compounded. The field magnets are of a special grade of steel. The direction of current in the field coils and armature is never reversed, and the machine is never demagnetized, because in hoisting the line E. M. F. predominates, while in lowering the reversed E. M. F. of the motor is the only active one in the armature circuit. It should be remembered that this type of elevators is differentiated from all other electrics in that, like the hydraulic, it always works against gravity; the motor takes current from the line in hoisting, but in lowering it is cut off from the line and is operated as a driven dynamo by the falling weight of the car.

The armature is ironclad, is of the two-path special slotted drum construction, has one turn of wire to each coil, and each turn is securely imbedded in an independent insulating tube rigidly held. The carbon brushes are double, have independent movement, and ample capacity to carry the full current without flashing. The neutral point is fixed. The machine is self-oiling and the bearings are independent of the field castings.

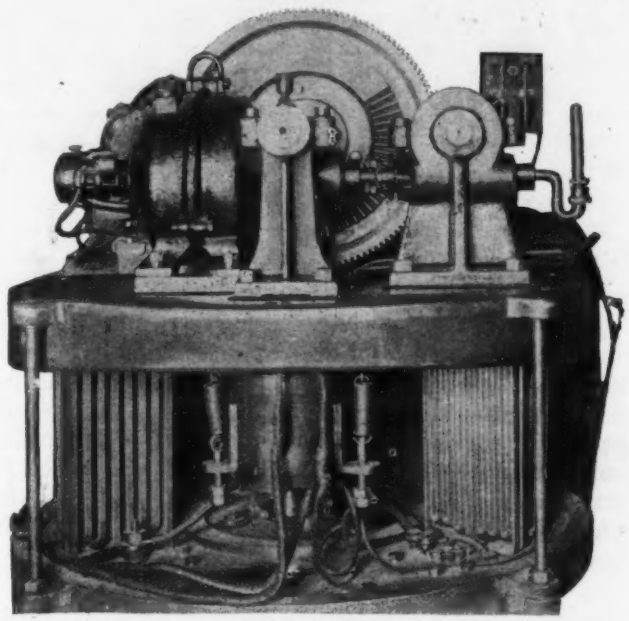
The last individual feature of the machine is the regulator

and the method of operating it. This is shown below, but since this photograph was taken the apparatus has been simplified and the cables and devices shown in the interior removed. This apparatus is an independent one and connected to the hoisting machine only by the wires necessary for the circuits. It is, in brief, an open cast iron frame carrying inside a slate disc having on the lower side a row of bronze contact clips, and on the other, attached to these clips and to each other by tap screws, a series of grids arranged in a circle. These grids are about 9 inches long, 4 inches wide and 3-8ths of an inch thick, and are cast in a form somewhat resembling a ribbon folded on itself. They are freely flexible when taken separately, although iron is one of the principal ingredients. The resistance averages about fifty times that of copper. The grids can stand a very high current and the temperature coefficient, while not constant, is sufficiently small not to be objectionable.

On top of the frame is carried a 1-4-h. p. motor connected to the car switch through a pilot board by a cable of four insulated wires which operates the rheostat and circuit changers. The motor is coupled to a worm gear which carries a small pinion meshing into a spur gear on the circuit changer and controlling cylinder. This cylinder has a bevel gear driving a pinion on top of a vertical shaft at the lower end of which is the rheostat brush arm. This brush arm carries carbon brushes which bear on the bronze clips. There are 120 of these, and the difference of potential between them is too small to allow any sparking. A quick acting circuit breaker prevents arcing at the first clip. The operator in the car is at liberty to put the brush at any point of its travel and leave it there as long as necessary. The same rheostat is used in hoisting and lowering, and the arm travels over the whole range of clips in either movement. This operation is controlled electrically either from the car or from the pilot controlling the switchboard in the engine room.

In hoisting, as seen from the car, the operator moves a small lever and the car starts with a perfectly accelerating speed, no jerks or pulsations being felt. Ordinarily he puts the car to full speed and makes his stop exactly at the landing with one motion of the switch. If, however, he stops a short distance below the landing floor he can raise the car that distance as in a hydraulic elevator. The operator can regulate his speed from slow to full speed, which last may be as high as 600 feet per minute. A small rheostat in the field of the hoisting motor gives a fixed adjustment of about 10 per cent. variation in the maximum speed of the car.

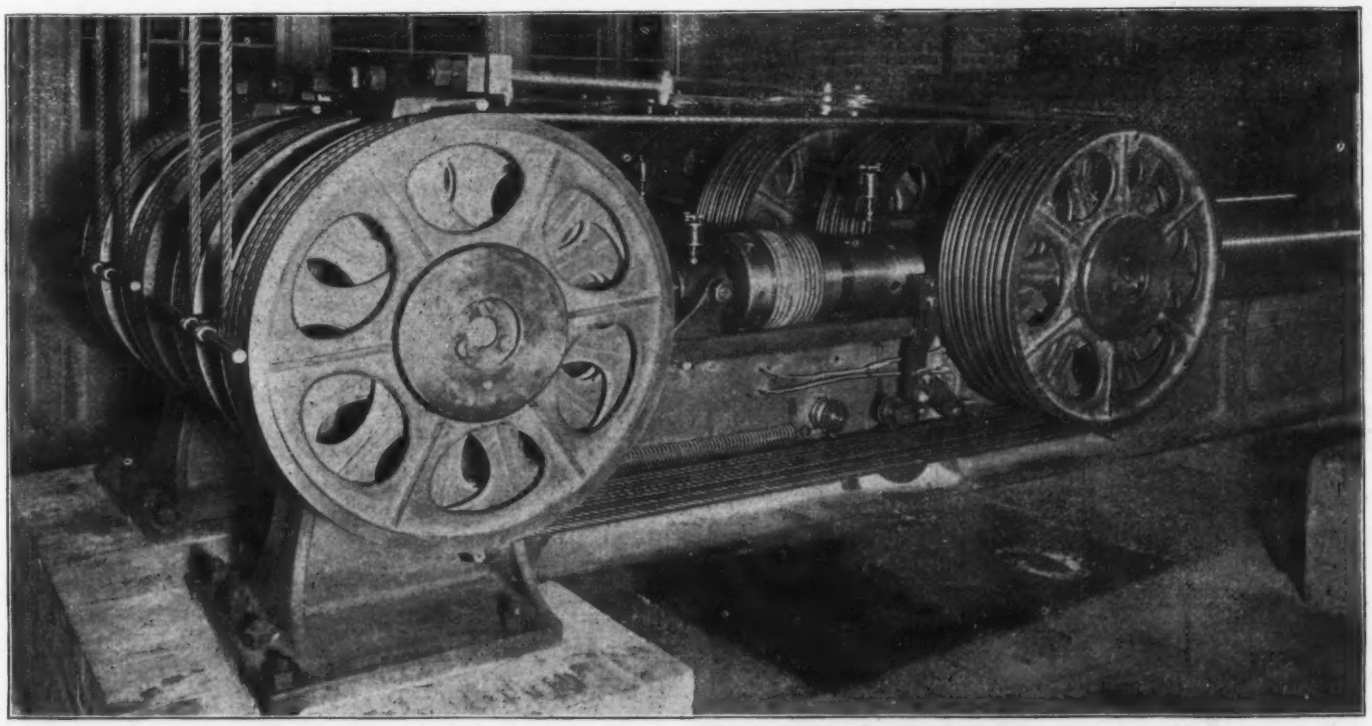
If the operator forgets or is unable to operate his switch



ELEVATOR REGULATOR.

to stop the car, there are two automatic stops which will only allow it to go a few feet above the top floor.

The moving of the switch to "up" puts current through the up coil of the pilot motor, which, moving the regulator, connects the main motor to line, sends current through the armature and a progressively reduced resistance, the current releasing the brake and increasing the torque until the armature begins to turn without shock or jar, and thus accelerates the car in a perfectly timed progression. A return of the switch to "steady" instantly arrests the movement of the rheostat arm, checks the pilot motor by an automatic brake and stops the acceleration of car speed. A return to "stop" cuts



HOISTING NUT AND SHEAVES OF ELECTRIC ELEVATOR.

off the current, gradually but more promptly than the reverse movement is made.

In lowering, the rheostat brush closes circuit on the zero resistance clip, and at the same time closes a circuit through a shunt coil on the brake magnet, releasing the brake. The motor now becomes a separately excited compound dynamo with the weight of the car to drive it.

There is no effort of the motor exerted to aid the car in lowering. The friction for the weight of the car to overcome in order to start this dynamo load consists of that of the car guides, overhead sheaves, multiplying sheaves, the crosshead guide, the ball-bearing nut, the thrust bearing of the screw, and all the screw and armature bearings. The fact that 500 pounds on the hoisting ropes will overcome this and start the motor instantly is due to the use of rolling friction on all sheaves, the nut, and the screw thrust bearing.

It is impossible to attain a rapid acceleration of speed on the start down, for at the first position of the rheostat brush the torsional resistance of the armature will not allow the full carload to drive it above 5 per cent. of its normal speed, and from there to the highest resistance there are 120 variations of speed up to the maximum. Aside from this, the mechanical conditions of starting a screw to revolve by pressure on the nut from a limited force when the pitch is slight and the inertia of the armature is considerable render a sudden start impossible and insure an even acceleration of speed independent of the dynamo action.

When the car is within about six feet of the lower landing a roll on the travelling sheaves engages a lever that reduces the resistance in a by-path in the armature circuit and brings the car to an easy stop at the landing independent of the operator.

Besides the control from the car there is provided in the basement a general controlling switchboard by means of which the control can be taken from the switch in any car and transferred to the switch in this board. In this way general inspection, cleaning, testing, or, if needed, replacement of any part of the regulator or machine, whether in the ordinary course of affairs or in case of accident, and the hoisting of safes, all can be carried on from below without an operator in the car; in fact, even while in motion the control can be instantly taken from the operator and the car run from the pilot board.

The care and attention required by an elevator of this type as compared with the hydraulic plant are in its favor, for, aside from the ball-bearing nut, there are no more parts to attend to and renew than there are in an ordinary electric elevator. The thread of the nut is hardened by a special process that renders it for a depth of one-fourth of an inch as hard as steel can possibly be made. The thread is afterwards ground true and smooth. Tubes are then inserted to circulate the balls from one end to the other. The balls are one-half inch in diameter and of standard make.

One of these nuts has run for 24 hours a day for 16 months, and was only removed twice in that time for inspection. The operating nuts of the Postal Telegraph plant, although at times under vicious duty, show no wear of the working thread. As illustrating the facility of access, a car can be slung by its ropes from below, the end screw bearing, the buffer nut, and the working nut all removed, the balls taken out and inspected, the nut cleaned, and the whole restored and the car put into operation again within thirty minutes. The balls in the nut can be inspected while the machine is in operation.

The multiplying sheaves run on bearings which show no wear at all and do not require oiling or cleaning more than once a year. Not a drop of oil runs out of them. There are four nests of sheaves on this elevator and any nest can be exchanged for a spare nest within five minutes after the ropes are slacked. A machine can be absolutely dismantled and practically every working part laid on the floor in an hour and a half.

As to the question of safeties, the following elements may be considered: First, the screw; this is a bar of special forged steel under tension and torsion strains, and capable of sustaining twenty times the heaviest load applied to it. Second, the hoisting nut; this is of special steel hardened and finished by a special process. In addition to this is a safety nut. This nut is normally out of contact with the screw's thread; it is secured to the hoisting nut, and should any accident happen to the latter which would break its hold on the screw's thread, this safety nut, the thread of which interlocks with the screw's thread to a greater depth than the thread of the hoisting nut, would then take the place of the hoisting nut and form an anchorage to hold the travelling sheaves with a grip exceeding the strength of the screw. This would put the elevator out of operation, as the friction between this nut and the screw is greater than the friction caused by the pressure of the travelling sheave crosshead against it; this nut would then act simply as a collar on the screw, and revolving the screw would transmit no motion to the car.

There is another safety in the nut system, however. As before stated, the hoisting nut is only held from revolving by its friction against the crosshead; when the nut gets to the upper limit of its travel the safety nut meets a solid collar on the screw, which stops its travel and causes it and the ball-bearing nut to revolve with the screw, thus stopping the travel of the nut absolutely without stopping the motor, and allowing the travelling sheaves to be stopped simply by the weight of the car. This stop has been made at full speed without any injury whatever.

Another important function performed by the hoisting nut in a very simple and direct way is its action as a slack cable device. The car descending at high speed and driving the nut along the screw, revolving the screw and armature thereby, meets an obstruction, the pressure against the nut is reduced to only that given by the weight and sag of the ropes and the working nut recedes slightly, which allows the spiral spring between the safety and ball bearing nuts to extend and force the safety nut against the back of the screw's thread. The friction then between the nuts and the screw is greater than between the safety nut and the crosshead, therefore the hoisting nut at once revolves with the screw, its travel along the screw ceases, and it checks the travel of the travelling sheaves before the cables are really slack.

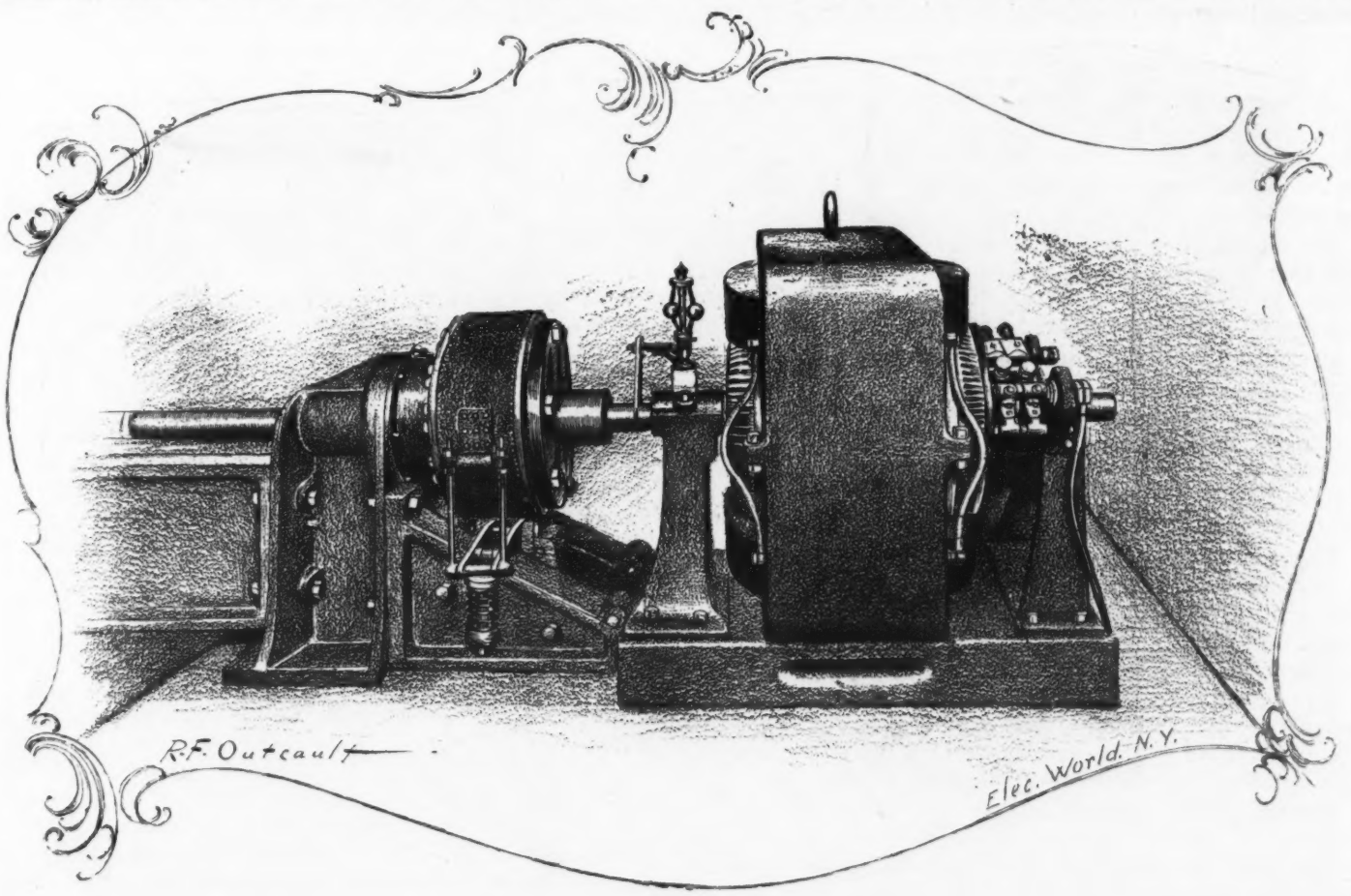
It is moreover evident that if the screw should become free to revolve unchecked by motor or brake, the weight of the car would not cause the screw to revolve at a speed at all comparable to a free fall. In any event, there remains the rubber buffer at the lower end of the screw to cushion the end of such a run. The use of the buffer, as well as the frictionless character of the nut, have been most effectively illustrated by actual drops from heights up to the twelfth story. This buffer nut can stop a car going at a speed of 800 feet per minute in 24 inches without starting a bolt or fastening.

The rope fastener used on this elevator consists of a solid body of metal, which has a double spiral groove; the ropes enter this groove by being passed through a loop in one end, wound twice in one groove, passed through a loop in the other end, returned in the other groove in spiral convolutions between the first winding and out through the loop in the first end. This engages about 3 feet of the rope, instead of about 3 inches, which other rope fasteners hold. There is but one way that a rope can be put in this fastening, and it will hold almost any size rope equally well. Tested in Fairbanks' testing scales it took 10,500 pounds to break a 5-8-inch iron wire rope, which gives this rope a higher rating than quoted by the makers in their catalogues.

Besides the lower limit switch already described there is an upper limit switch for cutting off the current. This is a double-operating and self-cleaning lock snap switch, moved by a roll on the crosshead, and cuts off the current in hoisting at the upper limit, allowing the brake to come on and stop the car. On the reverse movement the circuit is closed for hoisting.

The centrifugal on the machine for operating the brake when running down too fast has already been mentioned. This is set to operate at a small excess above the allowed speed. It does not interfere with the operation of the car centrifugals, but simply puts the brake on the machine in case of limited excess of speed, and is ready for use again as soon as slowed down instead of being tied up, as is the case when a car safety works.

In regard to the question of economy, the Sprague-Pratt company make the following claims: While buying current from the street system at the rate of 5 cents per horse power hour, reckoned on an 850-watt rate, pending the operation of the local plant, the cars have been operated at a cost not exceeding 3-5ths of a cent per round trip of 26 floors, which is not over 40 per cent. of the cost of operating a like hydraulic system, even with an independent plant. The standard hydraulic elevator, as now operated, is supplied at a practically constant pressure by a compression tank automatically regulated in the basement, or a roof tank, which may also be a compression tank. Whatever the load identically the same amount of water at the same pressure is used for every foot of travel, and consequently no matter how light the car may be running, it always uses the maximum power. Statistics taken time and again prove that the average live load on a passenger car is not over one-fifth the maximum which it can carry. Including the counterweight, which in a high-speed hydraulic elevator is, fully four hundred pounds lighter than in an electric elevator of equal capacity on account of the difference of friction, the total average load is about a third of the maximum. For an example, take a car of 30 feet floor space. This can be loaded up to about 100 pounds per square foot, or 3,000 pounds live load, while the average live load will not be over 600 pounds. In a hydraulic elevator it would take about 900 pounds excess of weight in car over the counterbalance to insure proper running. This means a load of 3,900 pounds on the ropes, but this is not all. Since the speed of the car with any given opening of the valve is a function of the difference in pressure in the supply and the cylinder, and since there must be an excess of pressure on the supply side in order to have the car move at all, then to move this total load of 3,900 pounds at even a low speed, there must be a capacity to actually lift about 500 pounds more than this, or 4,400 pounds; yet the average load on the ropes is only 1,500 pounds. In a Sprague-Pratt electric elevator such a car can be operated with 600 pounds excess of weight, making an average load on the hoisting ropes of 1,200 pounds, and since this elevator uses power very nearly in proportion to the load over friction, we would have, as between the two classes of elevators, a constant equivalent duty on the hydraulic of 4,400 pounds and on the electric of 1,200. Here, then, is a difference of nearly four to one in favor of the electric, considering solely the question of work actually done in the cylinder and on the screw. Roughly speaking, the friction of the electric machine is quite as low, if not lower, than that of the hydraulic, because one is on ball bearings and the other has a tightly packed gland and piston. Going back now to the generation of power, the best pumps in common use require 70 to 85 pounds of water per horse power delivered to the water column, whereas electric power can be delivered to the mains of the motor for an expenditure of about 35 pounds of water.



VIEW OF ELEVATOR MOTOR AND BRAKE.

The switchboard of the plant is located in the centre of the dynamo room, and is one of the most interesting features of

the installation. It is the design of Mr. Paul Lemaire, the electrical contractor of the building, who has been ably assisted in the work by his superintendent of construction, Mr. E. Neilsen. The board is enclosed in the rear by a solid brick wall, access to the interior being had through a door at the right end. There is abundant space inside for inspection and repairs. The front of the board is of marbleized slate. Where bolts pass through the holes have been reamed out and fitted with a bushing of plaster and then covered with asbestos paint, thus insuring very high insulation.

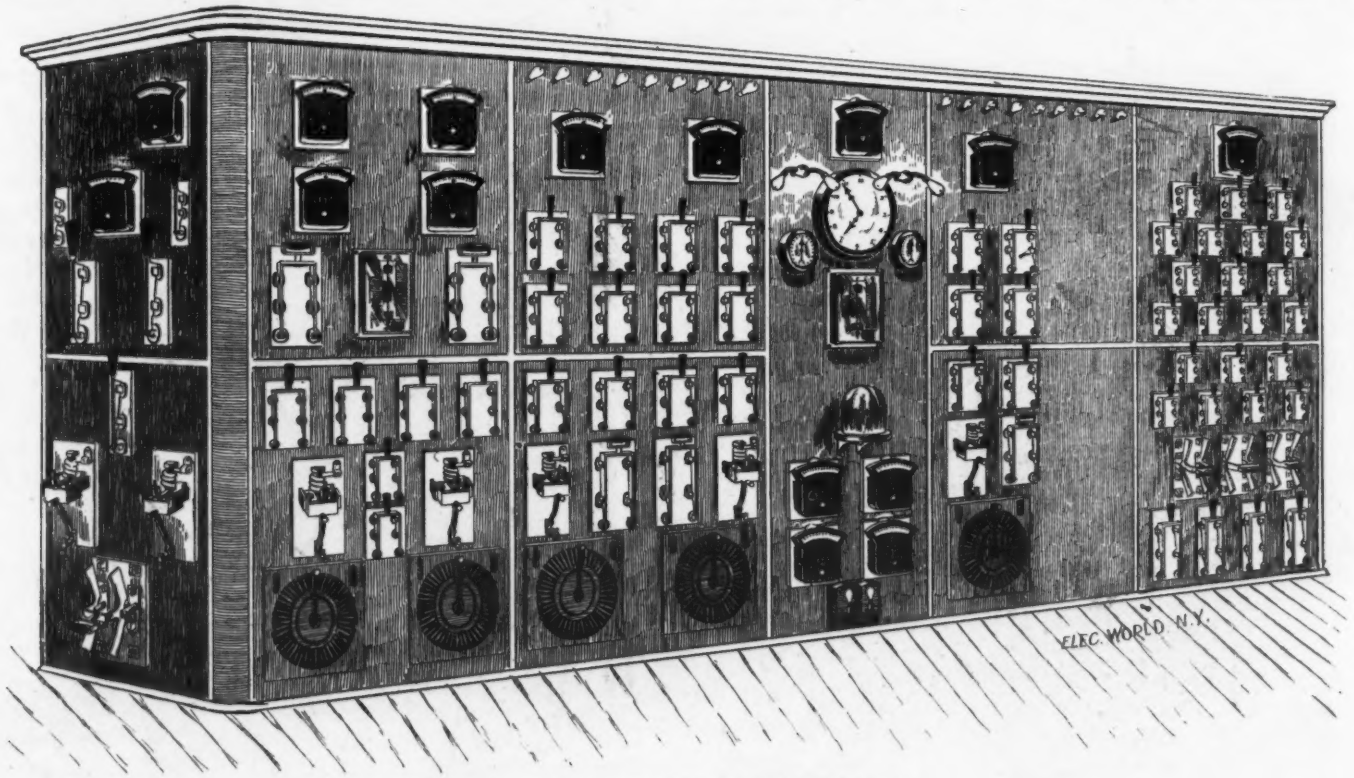
The accompanying illustration gives a view of the board. The front face consists of five separate panels, each devoted to a special portion of the plant. The panel to the right contains the switches which control the Postal dynamotor plant, each machine having its own switch. The four lower switches on this panel are double pole and so connected to four of the machines used for a reserve that in case of need they can be thrown in either as positive or negative. The next panel is devoted to one of the lighting machines, one-half of it being left vacant for the additional machines which will be installed later. It contains an ammeter, rheostat, magnetic circuit-breaker and main and circuit switches. The centre panel contains the main indicating instruments, a standard clock for supplying the time for the building, steam and vacuum gauges and an Edson recording pressure gauge. The next panel contains the controlling devices for the remaining two lighting generators, and the last to the front left controls the two power generators.

The left end of the board makes an angle of about 120 degrees with the face, and constitutes an auxiliary board for the Edison service. The plant has been running for some time on the street service. The board is thus arranged so that any of the panels can be switched on to the Edison service in case of an accident to the boilers. The electrical instruments on the board are all of Westinghouse manufacture except the voltmeters and ammeters, which are of the Weston type.

The building is lighted on the two-wire system, two sets of separate mains running from the bus bars to the distributing centres on each floor. A row of pilot lamps at the top of the board are connected to each centre of distribution and indicate whether the circuit is closed and also give a comparison of the candle power of the lamps on each circuit, with those connected to the bus bars. In order to provide for the Edison service three bus bars are used, two being ordinarily connected to form one side of the circuit. A separate bus bar is provided for the main indicating instruments. For public lighting two separate circuits, called the east and west circuits, are run from one switch at the distributing board on each floor to either end of the building.

Provision has been made for running the elevators from the lighting circuit, at half speed, if so desired at night when but few lights are needed and but a single elevator running. As the potential of the elevator circuits is 240, and of the lighting 125, care must be taken to avoid connecting the two. The power bus bars are connected to the lighting circuit by special switches, and a pilot lamp indicates whether the switch should be thrown or not. Additional safety is secured by a mechanical device, between the high and low tension switches, so that if one is closed with the other in circuit, the latter is automatically opened.

The wires, both for the lighting and telegraph plants, is of the Safety Insulated Wire Company's make. Over 100 miles of safety cable is used in which are from four to fifty wires. For the circuits 150,000 feet of Nos. 12 and 14 was required; 150,000 feet of the New York Insulated Wire Company's Vulca ducts, and 7,000 feet of Interior Conduit and Insulation Company's brass covered tubing. The fixtures and electroliers are from the Central Gas and Electric Fixture Company. Edison lamps will be used throughout, except where arc lamps are employed.

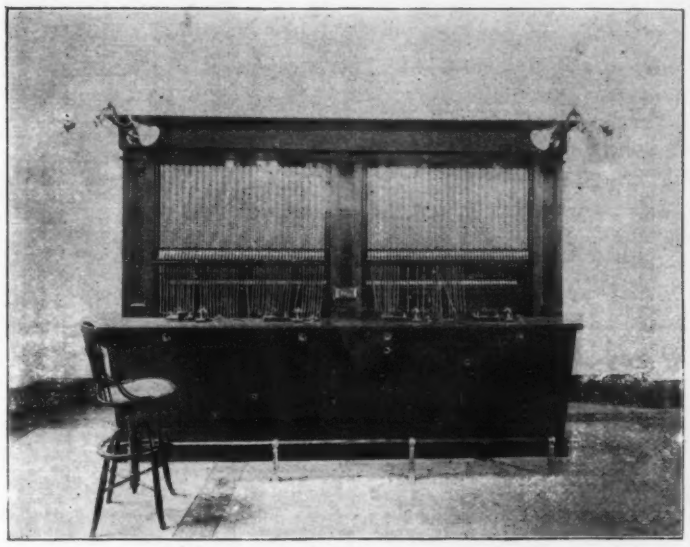


GENERAL VIEW OF THE SWITCHBOARD.

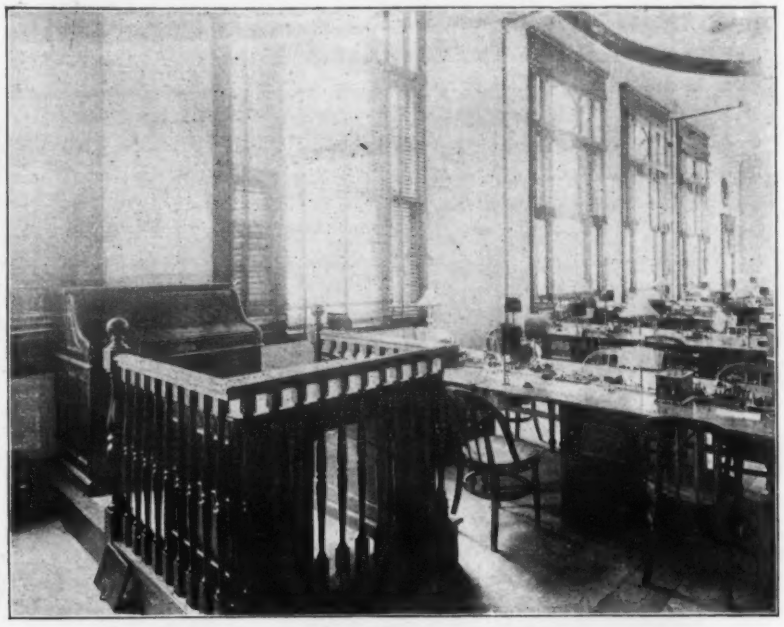
In the basement, over the sub-basement, is located the distributing board of the Postal company's plant, providing connections between the subway cables and the wires to the switchboard in the operating room. This board is made of iron and slate and is entirely fireproof. Six cables come in from the subways, three carry 78, two 63, and one 104 conductors.

The entire eleventh floor has been given up to the operating room of the Postal company, and no expense has been spared to make this the most complete installation of its kind in the world. It is equipped with the most modern

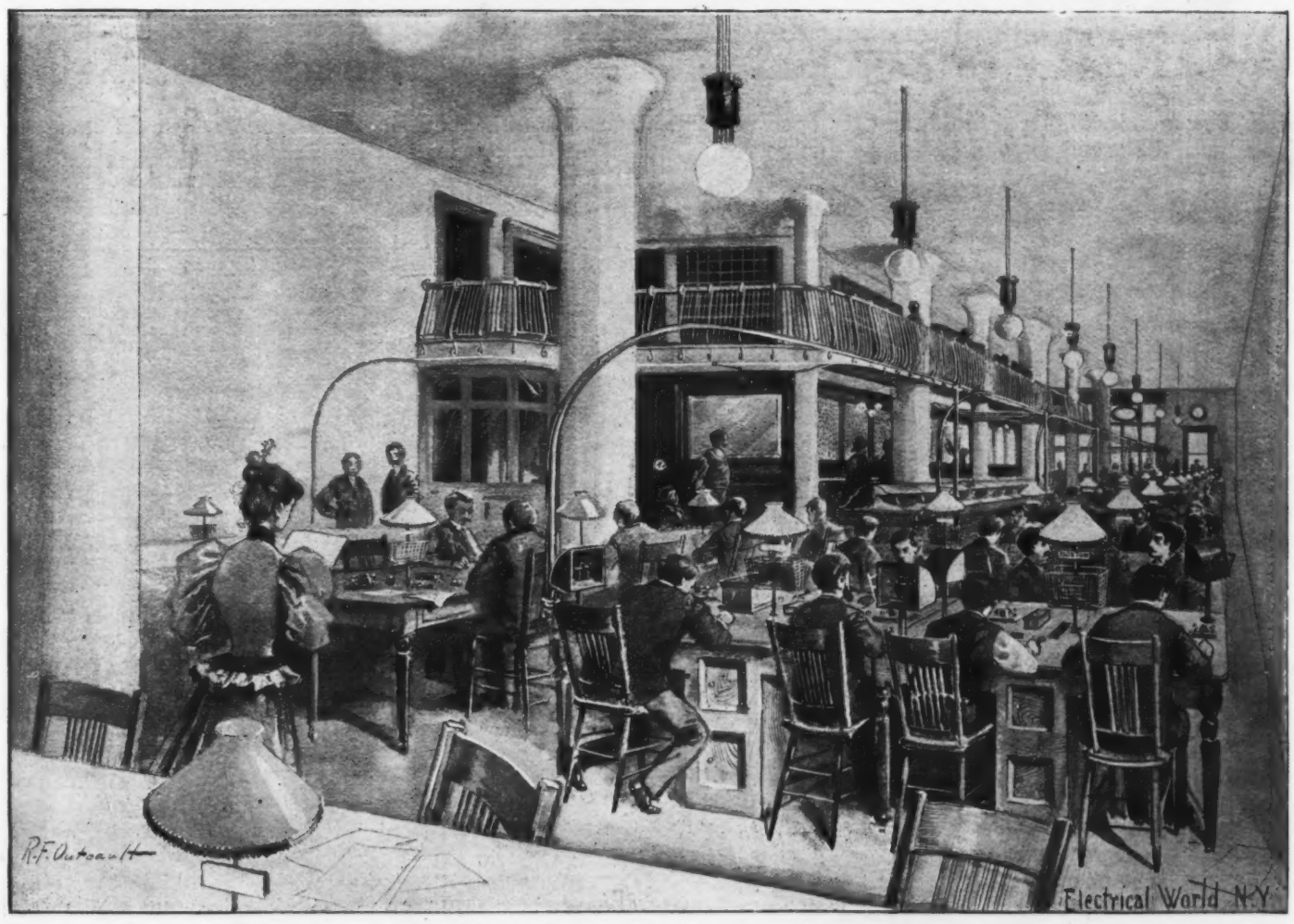
apparatus and embodies a number of new ideas, which will facilitate the handling of the company's large and constantly increasing business. The illustrations hardly give a fair idea of the size of the room, which extends the entire length of the building and across each end. Windows on three sides furnish an abundance of light and air. One of the accompanying illustrations gives a general view of the operating room from the southeast corner, while another shows from the gallery the northeast corner, which is hidden in the general view. The switchboard, a view of which is shown, is situated in that portion of the room. Another illustration presents a view of the main switchboard, while another gives a view of the manager's desk, taken from the same point, but looking in the opposite direction—to the south.



CITY SWITCHBOARD IN OPERATING ROOM.



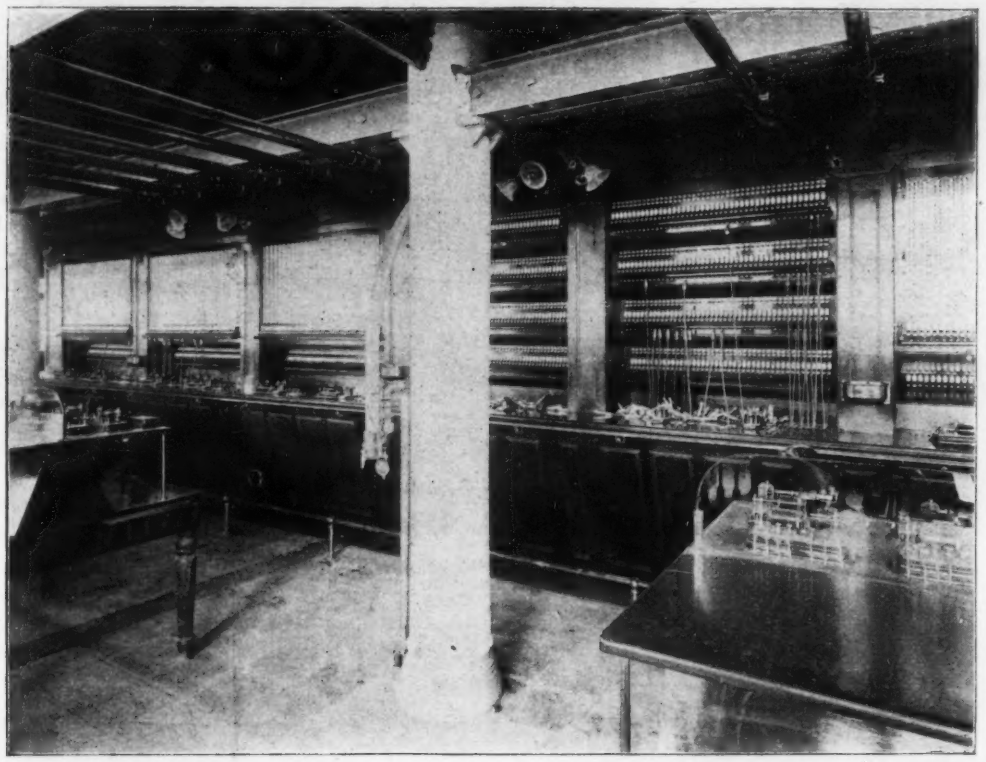
VIEW IN THE OPERATING ROOM.



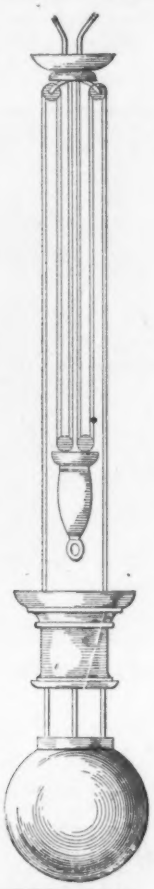
GENERAL VIEW OF THE OPERATING ROOM.

There are 308 sittings for operators in the room. It will be noticed that each table is arranged for four operators, two tables with accommodations for eight being placed end to

end. The tables and desks are of highly finished cherry. At variance with the common custom, the tables are not divided by glass partitions, this not being considered necessary with the use of "sounders." These sounders consist merely of a revolvable box, mounted on a standard, shaped like the quarter of a cylinder, with one of the plane sides left open. The sounder is placed in this and the operator turns the box until the sound waves are thrown directly in his ear.



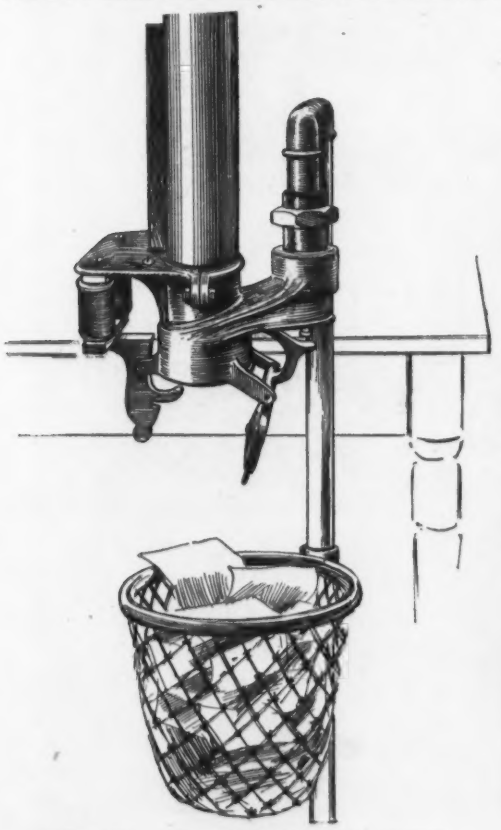
MAIN SWITCHBOARD IN OPERATING ROOM.



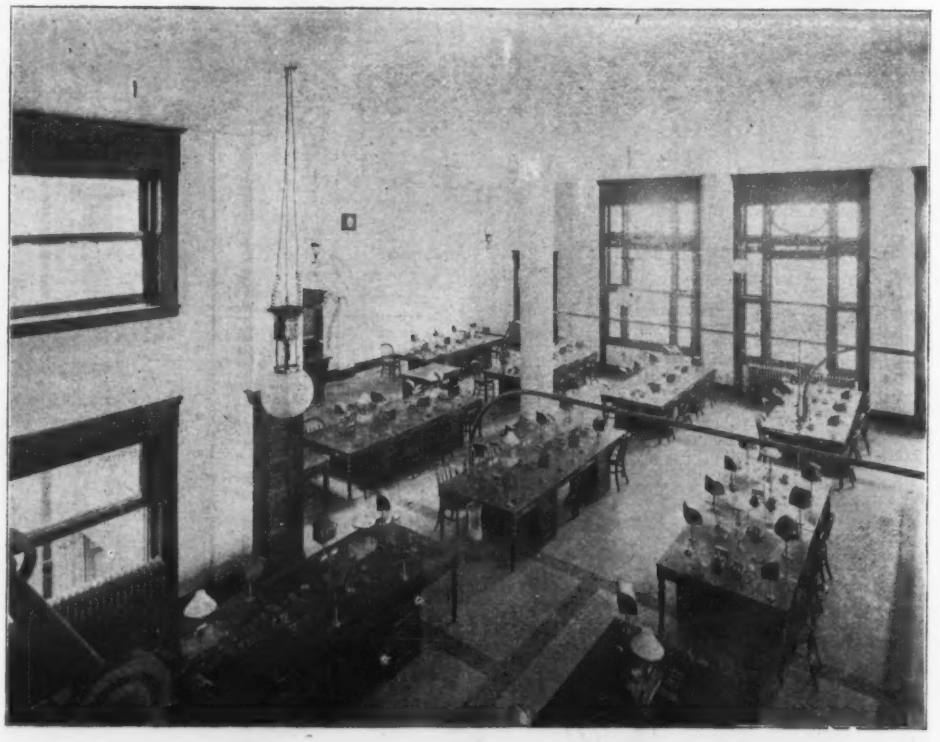
ARC LAMP IN OPERATING ROOM.

A brass rack on one end of the sounder is provided for the messages.

Another excellent idea is the provision made in each table for a typewriter, a section being cut out for this purpose. This saves the space occupied by the ordinary typewriter table. Each table is provided with an electric light standard with porcelain shade, upon which are hung wire baskets for the reception of messages and cards, showing the line connected to the instruments on the desk. Each desk is also provided with a Hayes fireproof fuse box.



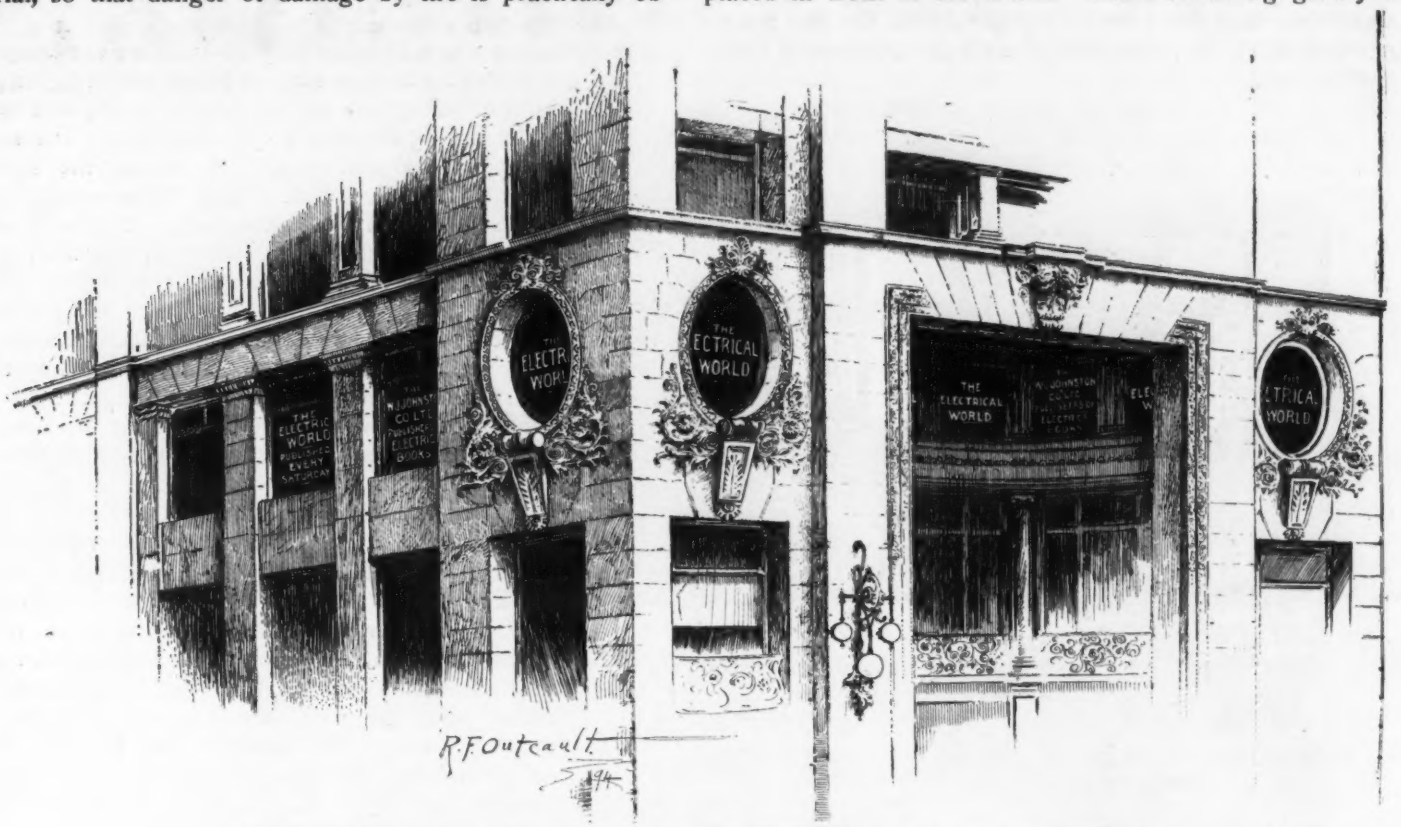
DETAIL OF PNEUMATIC TUBE.



EAST END OF OPERATING ROOM FROM GALLERY.

The main switchboard is a magnificent specimen of work. It was made by the Western Electric Company. The board is fireproof in construction, being made of

marbleized slate and the wires insulated with fireproof material, so that danger of damage by fire is practically obviated. The board contains eight sections, with space for two more, giving a present capacity of 400 wires. The loop switch, which, though a part of the system, is independent of the main wire switches, has a capacity of 372 legs. The double-decked tables for the repeaters, as shown, are placed in front of the board. The distributing gallery is above the switchboard. All messages are sent here to be assorted for distribution. A pneumatic tube system has been installed to replace messengers in collecting and distributing messages to different parts of the room. Thir-



WHAT ATTRACTS THE ATTENTION OF ELECTRICIANS ON BROADWAY.

THE ELECTRICAL WORLD OFFICES—RECEPTION ROOM.

teen tubes diverge from the gallery and are so distributed as to divide the floor area into equal parts. There are also four tubes running to the city department on the first floor. An electrical device, the invention of the company's elec-

THE ELECTRICAL WORLD OFFICES—ENTRANCE TO THE BUSINESS DEPARTMENT.

trician, Mr. F. W. Jones, has been attached to the system, which renders it practicable for this service. It is shown in detail above, and can be readily understood from the drawing. As the carrier emerges from the tube and drops into the basket, it makes a contact, closing a circuit which energizes the electromagnet attached to the tube at the starting point. The armature of this magnet releases the lid, which drops and closes the valve in the air supply pipe.

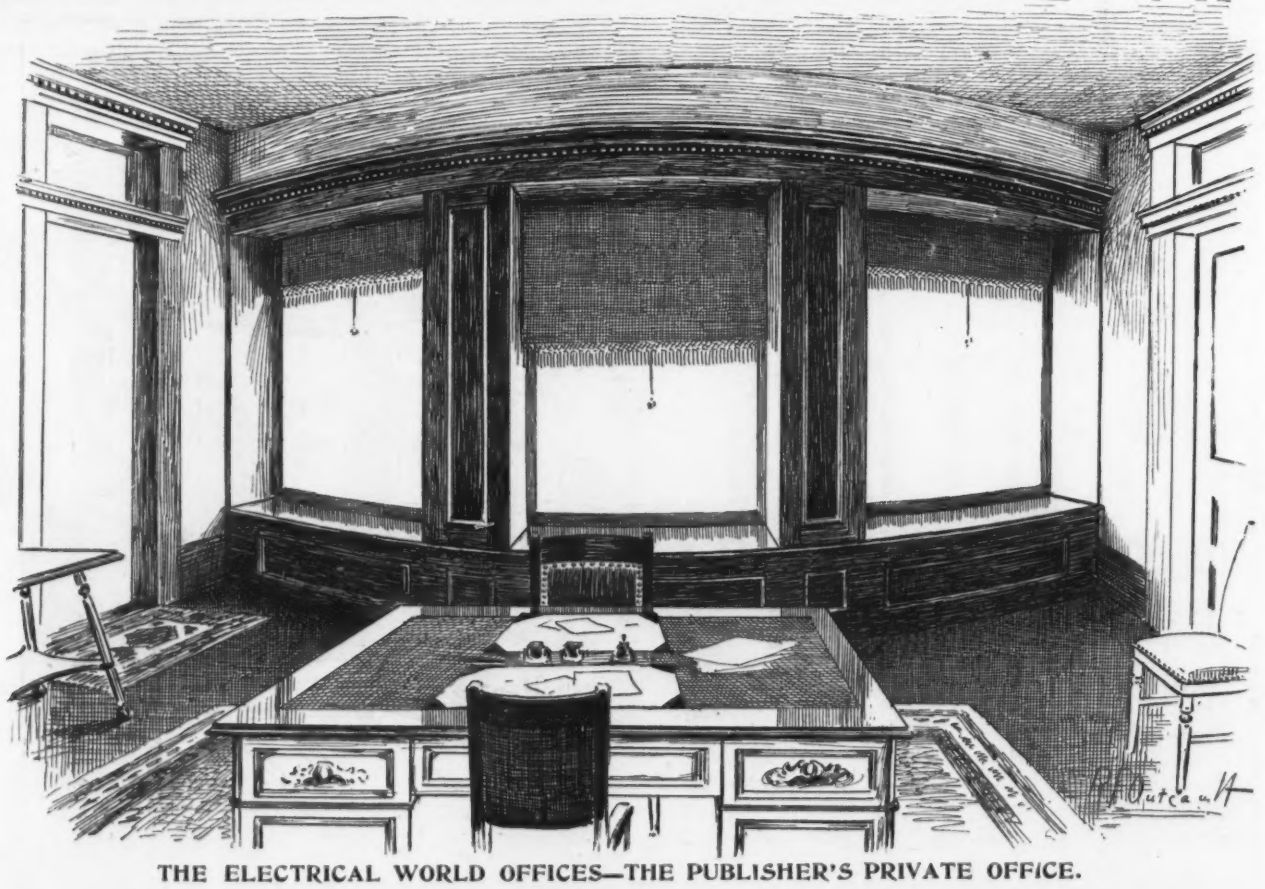
The telegraph instruments were furnished by the Western Electric Company and J. H. Bunnell & Co., and are of the most improved type.

The operating room is lighted by 16 Lemaire arc lamps, burning on the low tension incandescent lighting circuit. They are placed two in series, and require only 5 amperes at 50 volts each. The accompanying cut, page 536, shows the style of lamp and the simple sliding device employed to vary the height of the lamp. Eighteen of these lamps will also be used on the first, or ground, floor of the building.

It is thus evident that the Postal Telegraph-Cable Company and the Commercial Cable Company have found a home suited in every way to their needs, with facilities for handling the continually increasing volume of their business. The provisions made for the comfort of the other tenants are equally complete.

THE ELECTRICAL WORLD OFFICES.

Adjoining the magnificent edifice in which this journal has just taken up its abode is the building known as No. 9 Murray street, one of the few old and modest structures now remaining in the vicinity. At No. 9 Murray street was located the first office of The Electrical World—in a small room near the roof. Modest as were these quarters, their rental marked a step in advance, as previously the sole address of the young journal had been P. O. Box. 3,332, and a gratituously furnished desk at the printer's answered both for a business office and an editorial sanctum. As years passed by more rooms and nearer the ground were taken, until finally growing business required larger facilities, which were found in the Potter Building, though at a rental thrice that paid in Murray street. The next move was to still more commodious quarters in the "Times" Building, in which The Electrical World was the first tenant to take



THE ELECTRICAL WORLD OFFICES—THE PUBLISHER'S PRIVATE OFFICE.

rooms, as it has been one of the first to move into the Postal Telegraph Building.

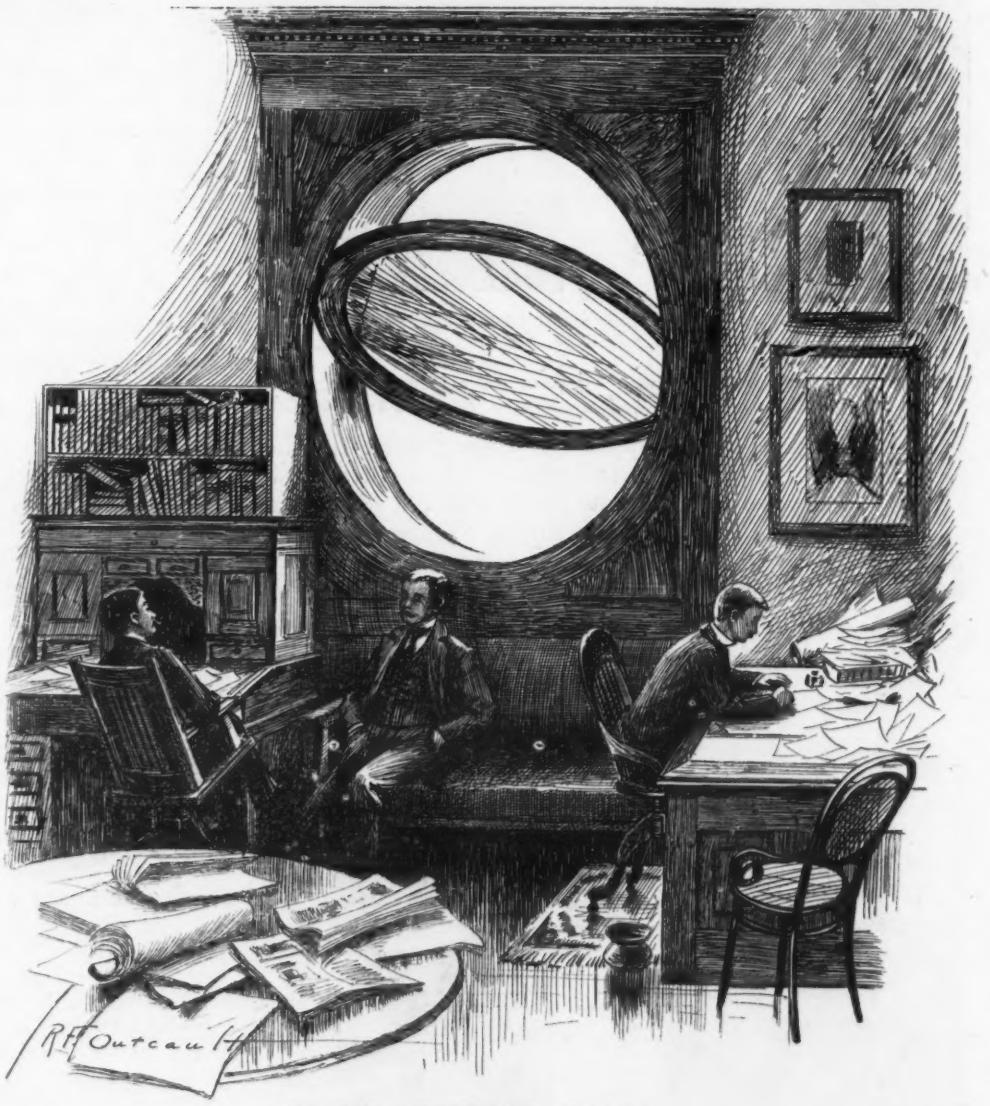
It is a little remarkable that notwithstanding the rapid development of the paper, it should have changed its address only twice in two decades—for this is its third removal—and that the different buildings it has occupied are all in sight and within gunshot of each other. Its old postoffice box, 3,332, it continued to occupy until the postoffice at the beginning of this year abolished all boxes bearing a number over 3,000, and it was assigned a new one, 769. The paper used by The Electrical World, moreover, has been supplied by the same mill for almost the entire twenty years, and much of the work on it not done in its own office has been in charge of those who have attended to it about the same length of time.

A CORNER IN THE SHIPPING DEPARTMENT.

The location chosen by The Electrical World in the new building at 253 Broadway comprises the entire front of the third floor and extending 40 feet on Murray street. Whether one walks up the two easy flights or ascends by one of the Sprague-Pratt elevators, on reaching the third floor and turning to his left he will find the offices of The Electrical World directly in front of him.

From the hall one immediately enters the reception room, where everything will be found arranged for the convenience of the visitor. An attendant will take his card, or announce his name, if he desires to see any one connected with the business or the editorial department, or place at his disposal files of the various electrical papers, or permit him to examine electrical books from the cases containing a copy of every electrical book in print. On either side of the reception room arches open, on the right to the main business office and on the left to the editorial and other departments, while adjoining the reception room is the private office of the publisher. The Broadway side of this room is formed by three of the seven windows of the great hemistyle which furnishes such a noble setting for the main entrance to the building. From this office—as well as from the business office on the right and the editorial rooms on the left—a fine view of Broadway is obtained, extending across the City Hall Park and taking in the great newspaper buildings on the other side, including the two former abiding places of The Electrical World.

To the right of the reception room is the main business office, a room 24 by 40 feet, in which is employed the force necessary to attend to the vast and growing details of The Electrical World, its publishing and bookselling departments and the correction and preparation of that now almost absolutely necessary annual, "Johnston's Electrical and Street Railway Directory." To the left of the reception room is a space of the same dimensions as the business office,



IN THE EDITORIAL ROOMS.

but divided into editorial rooms, a mailing room, a circular room, and extensive alcoves for books, papers, cuts, circulars, etc.

The main editorial office faces on Broadway, and is a secluded nook, very advantageously situated and well supplied with the necessary equipment, including a reference

library and a file of every electrical periodical in the world —always at the disposal of those making special researches. Near by is the office of the proofreader and advertising editor, also fronting on Broadway and taking in the two northern windows of the hemistyle, the corresponding windows on the southern side opening into the business office.

In the mailing room are the letter files, in which are kept, so arranged as to be easy of access when wanted, the extensive correspondence of The Electrical World and its different departments. Outside of this is a large room where several employees are constantly engaged in addressing circulars regarding The Electrical World or inquiries for data for use in the directory. Adjoining are alcoves containing, among other things, thousands of cuts, circulars, etc., and a large stock of electrical books, probably the largest carried on this continent.

BIRTH AND GROWTH OF THE POSTAL COMPANY.

The history of the Postal Telegraph-Cable Company, from its birth in 1881, has been somewhat varied, but with remarkable singleness of purpose the leading spirits of the organization have pursued a far-sighted, conservative, business-like policy which has finally resulted in the substantial success which the company now enjoys. Only those who have actively participated in the organization and development of a telegraph company can appreciate the difficulty of the task, and only those thoroughly familiar with the history of the electric transmission of intelligence, realize the number of disasters that have overtaken such attempts.

Geo. G. Ward

General Manager Commercial Cable Co.

E. C. Bradley

Assistant General Manager Postal Telegraph-Cable Co.

In the belief that the use of a compound wire and a multiplex system of telegraphy would render it possible to transmit a large amount of business at much lower rates than those in vogue at the time, and thus confer material advantage over all rivals, a company was incorporated on June 21, 1881, under the laws of the State of New York. It was called the Postal Telegraph Company, and the capital stock

J. H. Emerick

L. D. Parker

General Superintendents Eastern and Western Divisions.

was $21,000,000. The system adopted was based on the Leggo automatic and the Gray harmonic telegraph. The conductor was made upon plans devised chiefly by Chester Snow, at Ansonia, Conn., and consisted of a steel wire heavily coated with a deposit of pure copper, giving great strength and conductivity. A two-wire line was very thoroughly constructed between New York and Chicago and thence to St. Louis, extending also to Washington and several other important centres. With a capitalization entirely out of proportion to the cost of construction, which had amounted to about $3,000,000, the company could hardly anticipate immediate success, and for some years struggled in an effort for existence.

Meanwhile the Commercial Cable Company had been organized. It was thought that another Atlantic cable might

J. Cochrane

Geo. H. Usher

Superintendent and Assistant Superintendent of New York District.

be made a profitable investment, and Mr. J. W. Mackay, Mr. John W. Garrett and Mr. James Gordon Bennett proposed to assume equal interests in the new enterprise. A cable was constructed, and on Dec. 24, 1884, was placed in operation. Mr. Garrett, however, withdrew before the completion of the cables, his interest being acquired by Mr. Mackay, and Mr. Bennett also relinquished the major portion of his share, which passed into Mr. Mackay's hands. A uniform rate of forty cents was established at the start, the rate of the rival companies being fifty cents. The result was one of the most bitter warfares in the history of telegraphy which lasted for a period of two years and two months, at a loss, it has been estimated, of over $5,000,000. The competitive companies reduced their rates to twelve cents per word, in an effort to force the Commercial company out of the field. The

T. A. Jones

Electrician.

M. M. Davis.

Assistant Electrician.

Commercial lowered its rate to twenty-five cents but would go no lower. Its patrons, realizing that if the new company was driven out, the old rates, at least, and probably still higher ones, would be established, continued their support, with the result that the rival companies eventually raised their rate to twenty-five cents, which has been the uniform rate since that time.

In 1883, Mr. Mackay, in undertaking to financially assist a friend, became largely interested in the Postal Telegraph Company. In order to place the property upon a better basis a new company was subsequently organized with an authorized capital of $10,50c,000 in stock and $10,000,000 in bonds, called the Postal Telegraph-Cable Company, The company, however, continued on a non-paying basis, and in the summer of 1884, the Baltimore and Ohio Telegraph Company and the Bankers and Merchants' Telegraph Company determined to join interests with the Postal company. Almost immediately after, however, the Bankers and Merchants' company went to pieces and the Baltimore and Ohio company soon withdrew. The Postal company then sought the advice of Mr. A. B. Chandler, who had a wide experience in the telegraph field. Mr. Chandler recommended a reorganization of the company upon a new and diminished capitalization, and the extinction of the mortgage bonds. His plan was accepted and he consented to act as receiver of the company. The work of reorganization continued as rapidly as possible, but occupied a full year, at the end of which the presidency of the new company was offered to Mr. Chandler and accepted. During the past nine years the interests of the company have been zealously guarded by Mr. Chandler, and his honorable and conservative administration of its affairs, together with the sound views, right purposes and ample resources of Mr. Mackay, and the aid of the very efficient officers who were brought into the service, has finally brought the organization to its present prosperous condition. Unlike its predecessors the company has not sought to engage in a bitter warfare with its great rival, the Western Union Telegraph Company. On the contrary, the relations of the two companies have been friendly and the only rivalry has been that of a fair, although sharp and very active, business competition. The results of these methods have been crowned with success and the magnificent home which the Postal Telegraph Company has just found is a sure indication of its prosperity.

A Universal Shunt Box for Galvanometers.*

BY W. E. AYRTON AND T. MATHER.

Several years ago Mr. Latimer Clark drew attention to the fact that when shunts were used with a ballistic galvanometer in the comparison of the capacities of condensers, the results were inaccurate if the multiplying powers of the shunts were assumed to be the same as those employed with steady currents; shortly afterward the matter was investigated mathematically by the late Mr. Hockin, and he showed that the inaccuracy was caused by the change which the application of the shunt produced in the damping of the swing of the ballistic galvanometer. Hence the instantaneous deflection of a galvanometer when shunted showed an extra diminution, as if its resistance had been increased by an amount which depended on the details of the construction of the particular galvanometer, and on the adjustment of the controlling magnet.

In 1892, when giving a preliminary account of our "workshop ballistic galvanometers" at the Physical Society, we incidentally mentioned a method that we had devised of constructing shunts which entirely overcame this difficulty. At that time we had only perceived that our method of constructing constant damping shunts was of value in connection with ballistic galvanometers; but subsequently it occurred to us, when specifying the resistance of such constant damping shunts, that this method of construction not only removed the difficulty which had been pointed out by Mr. Latimer Clark in connection with ballistic galvanometers, but it enabled the same shunt box to be used with any number of different galvanometers of any resistance and of any type, and with an accuracy in the measurement far greater than could be obtained with the ordinary form of shunt box which had been specially constructed for the particular galvanometer.

As this method of making shunt boxes has not yet been published, and as it possesses important advantages of which we were not aware when we alluded to it at the Physical Society, we have thought that a short description of the method may interest the members of the Institution of Electrical Engineers.

To appreciate its advantages let us first consider the common, well-known method of constructing shunts, and the defects it possesses.

1. The resistances of the 1-10th, 1-100th, and 1-1,000th shunt must have exactly 1-9th, 1-99th, and 1-999th of the resistance of the galvanometer; therefore, if the resistance of the galvanometer be 1,c00 ohms, for example, the shunts must have 111·1, 11·11, and 1·111 ohms resistance; hence we must construct the 1-1,000th shunt accurately to the one-thousandth of an ohm if we wish it to be correct to even 1-10th per cent.

2. But the galvanometer is wound with copper wire; we are therefore at once met with the difficulty as to what wire we ought to employ in winding the shunts. If we use German silver, platinoid, manganin, or any substance of low temperature coefficient for the wires of the shunt coils, their resistances may be quite constant, but a rise of 10 degrees C. in the temperature of both the shunts and of the galvanometer will make an error of 4 per cent. in the resistance of the former relatively to that of the latter.

If, on the other hand, we wind the shunts with copper wire, then since the shunts are not inside the galvanometer case, it is very difficult to ensure, from the readings of thermometers, that there is not a difference of some two or three degrees between the mean temperatures of the shunt box and of the galvanometer, so that the resistances of the shunts may easily be 1 per cent. wrong relatively to that of the galvanometer.

In fact, except in the rare case when the galvanometer, as well as the shunts, are wound with German silver, manganin, or other wire of low temperature coefficient, it is useless spending time making accurate adjustments of the resistances of the shunt coils as ordinarily constructed.

3. Even if the resistances of the shunts be exactly 1-9th, 1-99th, and 1-999th of the galvanometer, they act as if they did not allow 1-10th, 1-100th, and 1-1,0coth, respectively, of the charge in a condenser to pass through the galvanometer when used ballistically.

4. Lastly, for each galvanometer there is needed a separate set of shunts.

All these defects arise from the fact that the method hitherto adopted of varying the current through a galvanometer while the current in the main circuit remained the same, has consisted in varying the resistance of the shunt to the galvanometer. If, however, we leave the shunt to the galvanometer untouched, and, instead, vary the current through the galvanometer by varying the point of attachment of the main leads, we remove all these difficulties at once.

A shunt box constructed in this latter way is seen in Fig 1. The terminals *A* and *B* of the shunt box are permanently connected respectively with the terminals of the galvanometer *G*. while the terminals *B* and *C* of the box are connected with the two main wires which lead the current up to, and away from, the galvanometer and shunt. The ends of a coil of *any* resistance *r* ohms are permanently connected as shown, and at points in this coil corresponding

*Paper read before the English Institution of Electrical Engineers.

with $\frac{r}{10}$, $\frac{r}{100}$, $\frac{r}{1,000}$ ohms permanent connections are made with the various blocks of the shunt box as illustrated.

Then, whatever be the resistance of this coil, r, compared with the resistance of the galvanometer g (either or

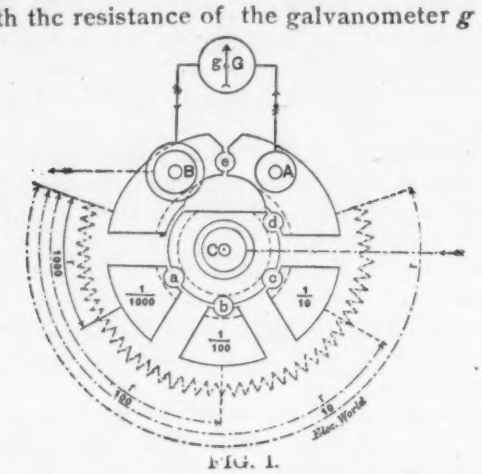


FIG. 1.

both of which may therefore be unknown), it is easy to show that if G amperes be the current flowing round the galvanometer when a plug is placed in the hole marked d, it will be $\frac{G}{10}$, $\frac{G}{100}$ and $\frac{G}{1,000}$ amperes respectively when the plug is put instead into the holes marked c, b and a respectively, provided that the current in the main circuit remains constant—the condition which is, of course, assumed to be true in the ordinary use of shunts. Or, if a definite quantity of electricity flow into or out of a condenser in the main circuit, and Q coulombs be the quantity of electricity that flows round the galvanometer when the plug is in the hole marked d, $\frac{Q}{10}$, $\frac{Q}{100}$ and $\frac{Q}{1,000}$ coulombs will be quantities that flow round the galvanometer when the plug is put into the holes c, b and a respectively, and the deflections will correspond with these quantities.

For let the constant current in the main circuit be called A: then, when plug is in hole d, the galvanometer current equals

$$\frac{r}{r+g}A, \text{ say } G$$

when plug is in hole c, the galvanometer current equals

$$\frac{\frac{r}{10}}{\frac{r}{10}+\left(\frac{9}{10}r+g\right)}A, \text{ or } \frac{G}{10}$$

when plug is in hole b, the galvanometer current equals

$$\frac{\frac{r}{100}}{\frac{r}{100}+\left(\frac{99}{100}r+g\right)}A, \text{ or } \frac{G}{100};$$

when plug is in hole a, the galvanometer current equals

$$\frac{\frac{r}{1,000}}{\frac{r}{1,000}+\left(\frac{999}{1,000}r+g\right)}A, \text{ or } \frac{G}{1,000}.$$

Similarly, if K be the number of coulombs flowing into, or out of a condenser in the main circuit, and pK, or Q, be the number of coulombs that flow round the galvanometer when the plug is put into the hole marked d, it may be proved that, *since the resistance of the galvanometer plus that of the shunt is constant, and therefore the damping is constant,* the quantities of electricity that will flow round the galvanometer when the plug is put instead into the holes marked c, b, a, respectively, are $\frac{Q}{10}$, $\frac{Q}{100}$, $\frac{Q}{1,000}$ coulombs.

Hence the galvanometer may be wound with copper or with any other wire; a single set of shunts may be made of manganin wire, and be accurately subdivided into *exact* numbers of ohms, *fractions of an ohm being unnecessary with our system;* the galvanometer may have any resistance and be at any temperature, provided it is constant while a set of tests is being made, then the subdivision of a steady current or the subdivision of an instantaneous rush of electricity into parts having the ratios of 1, $\frac{1}{10}$, $\frac{1}{100}$, $\frac{1}{1,000}$, is effected with *great accuracy.*

The arrangement of shunt box illustrated in Fig. 1 may be regarded as possessing one defect—viz., that the whole current flowing in the mains cannot be sent round the galvanometer without disconnecting the main wire from the terminal C and connecting it instead with the terminal A. To save the trouble of having to do this, and to enable every combination to be made by simply shifting the plugs, we sometimes construct the blocks of the shunt box as seen

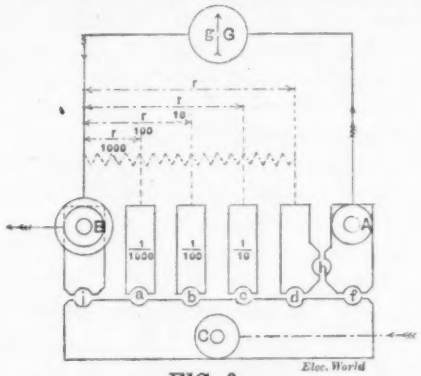


FIG. 2.

in Fig. 2. When one plug is placed and left in the hole marked h, and a second plug is placed in one or other of the holes marked d, c, b or a, we obtain exactly the results already described in connection with the box seen in Fig. 1. Placing, however, one plug only in the hole marked f, the entire current flowing in the mains circulates round the galvanometer. If a plug be placed in the hole f, and another in the hole j, the galvanometer is short circuited—a result obtained by placing the two plugs in the holes marked d and e in Fig. 1. The arrangement shown in Fig. 2 has the further advantage that it is possible, by putting a single plug into the hole marked j, to disconnect one terminal of the galvanometer from the circuit without breaking the circuit. This method of connecting is convenient to employ when taking the zero with a very sensitive galvanometer, for in that case it may happen that, although the galvanometer is apparently short circuited, through a very low resistance, enough of the main current, although but an extremely small fraction, passes round the galvanometer to produce a small deflection.

When, however, r is more than about ten times as great as g, the simpler form of shunt box illustrated in Fig. 1 is sufficient for ordinary purposes; for, although by merely shifting the plug with this type of box, it is impossible to send a greater current round the galvanometer than $\frac{r}{r+g}A$ amperes, where A is the current in the mains, this value of G, being more than $\frac{10}{11}A$, is sufficiently near A for ordinary purposes.

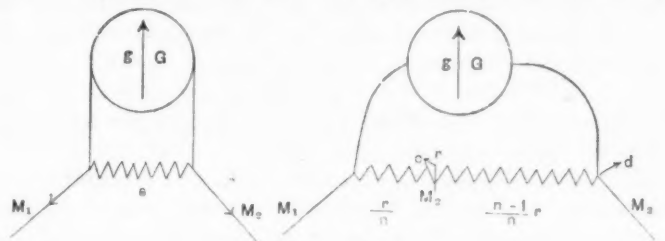
Of course, whatever be the value of r, whether large or small compared with that of g, the current that flows round the galvanometer when the plug is put into the poles marked c, b and a, respectively, is exactly 1-10th, 1-100th and 1-1000th of its value when put into the hole marked d. The only advantage that is gained by making r large compared with g is that $\frac{r}{r+g}A$, or G, the unit current, becomes then practically equal to A.

The method of using shunts above described has, then, the advantage that it enables the same shunt box to be used with any galvanometer of any resistance, whether ballistic or not; but it does more than that, for a consideration of our method of varying the point of attachment of one of the mains, instead of varying the resistance of the shunt itself, shows that any ordinary resistance box can be employed as a shunt with any galvanometer, and the fractions of the current that pass round the galvanometer and through the shunt respectively can be read off at once, without any calculation and without a knowledge of the resistance of the galvanometer, to a far higher degree of accuracy than is possible with a set of shunts specially constructed for the particular galvanometer in the ordinary way.

By employing this device we also find that great simplification and cheapening of cost are effected in the employment of a d'Arsonval galvanometer with shunts of platinoid or manganin sheet for the measurement of electric currents over a wide range.

It is well known that with the ordinary method of constructing shunts the resistance of the circuit is altered when the shunt is varied. An interesting question therefore arises whether this change in the resistance of the circuit is greater with the method that we have proposed of constructing a shunt or with the ordinary method.

With the ordinary method of keeping the main leads, M_1, M_2 (Fig. 3), permanently connected with the galvanometer G and of varying the current through the galvanometer by



FIGS. 3 AND 4.

altering the resistance s of the shunt, the change that is produced in the resistance of the circuit on applying this shunt is, as is well known, from g to $\frac{s\,g}{s+g}$; that is, the resistance is diminished by $\frac{g^2}{s+g}$. If then the shunt be such as to allow $\frac{1}{n}$th of the current to pass through the galvanometer, s equals g, and the resistance in circuit is diminished by $\frac{n-1}{n} \times g$ when this shunt is applied. For example if n be 10, the resistance of the circuit will be diminished by $^9/_{10}$ of g.

With our proposed method of keeping a fixed resistance r attached to the galvanometer G (Fig. 4), and of varying the current through the galvanometer by varying the connection of one of the main wires, for example, by moving the main wire M_2 from the point d to the point c the resistance of the circuit is altered from $\frac{r\,g}{r+g}$ to $\frac{\frac{r}{n}\left(\frac{n-1}{n}r+g\right)}{r+g}$; that is, the resistance in the circuit is diminished by

$$\frac{1}{r+g}\left\{\frac{n-1}{n}\,r\,g-\frac{n-1}{n^2}\,r^2\right\}. \qquad (1)$$

Now this expression depends not merely on the values of n and g, but also on the value of r. If r is selected so as to be less than $n\,g$, the expression (1) is positive; that is, the resistance of the circuit is *lessened* by shifting the main M_2 from the point d to the point c; whereas if r is selected so as to be greater than $n\,g$ the expression (1) is negative, which means that shifting the main M_2 *increases* the resistance of the circuit. Lastly, if r be chosen so as to be exactly equal to $n\,g$, shifting the main produces no change whatever in the resistance of the circuit, so that the current *now* passing through the galvanometer after shifting M_2 is exactly $\frac{1}{n}$th of the current that previously passed through the galvanometer, for the current in the main circuit undergoes no change whether the resistance of the circuit be large or small.

By selecting r then so that it is roughly equal to $n\,g$, our proposed arrangement gives the following result on shifting the main M_2 from d to c:

(a) If the resistance of the rest of the circuit be large compared with that of the galvanometer, the current that now passes through the galvanometer is exactly $\frac{1}{n}$th of that which *previously* passed, whatever be the temperature.

(b) If the resistance of the rest of the circuit be even small compared with that of the galvanometer, the current that now passes through the galvanometer is very nearly $\frac{1}{n}$th of that which *previously* passed, whatever be the temperature.

Contrasted with this we have, with the ordinary method of applying a shunt, the result:

(a) Even if the resistance of the rest of the circuit be large compared with that of the galvanometer, it is only when the temperature has one definite value that the current that now passes through the galvanometer is exactly $\frac{1}{n}$th of the current that *previously* passes.

(b) If the resistance of the rest of the circuit be small compared with that of the galvanometer, the current that now passes through the galvanometer is far greater than $\frac{1}{n}$th of the current that *previously* passed.

Lastly, whatever be the values of g, r and n, our method of altering the current through the galvanometer produces less change in the resistance of the circuit than the ordinary method. For, as already seen, with the ordinary method of applying a shunt, the resistance of the circuit is diminished by $\frac{n-1}{n}\,g$, while on moving the main M_2 from d to c with our method, the resistance of the circuit is diminished by

$$\frac{1}{r+g}\left(\frac{n-1}{n}\,r\,g-\frac{n-1}{n^2}\,r^2\right);$$

therefore, the ordinary diminution of resistance minus the diminution of resistance in our case equals the difference between these expressions, which is

$$\frac{(n-1)\quad(n\,g^2+r^2)}{n^2\quad(r+g)} \qquad (2)$$

Now, this expression (2) is always positive, when n is greater than unity, therefore our method of shunting produces the *less* change in the resistance of the circuit in all cases.

Annual Meeting of the General Electric Company.

The annual meeting of the General Electric Company was held at its offices in Schenectady on April 10. Proxies on a very large block of the stock were voted by Oliver Ames, second, of Boston, and the old board of directors of last year were re-elected. The date of the stockholders' annual election was changed from the second Tuesday in April to the second Tuesday in May. The fiscal year ends Dec. 31. The number of directors was changed from eleven to thirteen. No election of officers took place.

Competition for Self-Propelled Vehicles.

An enterprising daily paper of Paris has offered a series of prizes ranging from $1,000 down to $100 for self-moving vehicles, a test of which is to take place in Paris on June 1 of this year.

THE ELECTRICAL WORLD'S DIGEST

OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS BY CARL HERING

ELEC WORLD, N.Y.

(Note.—Owing to a delay in the foreign mails, some of the journals of March 15 to 31 have not yet been received.)

ELECTRO-PHYSICS.

Sound Produced by Light.—According to "Cosmos," March 17, Mr. Semmola found that by focusing intermittently the rays from the sun by means of a lens on to the diaphragm of a Hunning transmitter a sound will be produced in a telephone connected with it, the pitch of which will depend on the rate of intermittence; it is due to heat radiations, being increased if the diaphragm is blackened and disappears completely if the rays are passed through a heat absorbing substance; the bright spot should be sufficiently hot to carbonize paper; the diaphragm was 0.2 millimetres thick; the heat causes dilations and contractions, which produce the variations.

Cathode Rays.—Mr. Lenard's article, mentioned in the Digest last week, is continued in the Lond. "Elec.," March 30.

MAGNETISM.

Magnetic Field Inside of a Circle.—The Lond. "Elec. Rev.," March 30, contains a mathematical article by Mr. Rimington, in which he shows a method of approximately determining the magnetic field at any point inside of a circle carrying a current; it can be applied to any point not too near the edges; the width and depth of the coil are assumed to be negligible; the final approximate formula is

$$F = \frac{2\pi c}{r}\left\{1 + \frac{3}{4}\left(\frac{a}{r}\right)^2\right\}$$

in which F is the strength of the field (presumably in gausses or absolute units), c is the current (presumably in absolute units of 10 amperes), r is the radius and a the distance from the point to the centre of the circle (both presumably in centimetres); this is for one turn, if there are n turns the value of F must be multiplied by n; for applying this to the correction in a tangent galvanometer for small deflections, a is, of course, the half length of the needle.

Non-Magnetic Watches.—According to the Lond. "Elec. Eng.," March 30, the difficulty in the way of using palladium for non-magnetic watches seems now to have been overcome by using an alloy of that metal; it is stated that watches in which this alloy is used are now so well made that excellent Kew certificates can be obtained for them.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Universal Shunt-Box for Galvanometers.—The paper of Prof. Ayrton and Mr. Mather, read before the Institute of Electrical Engineers, is reprinted in full in another column.

Ruhmkorff Coils.—In an article by Mr. Armagnat in "L'Ind. Elec.," March 25, he gives a simple mathematical discussion of the various quantities and factors involved, including simple formulas for calculating the various quantities. The induced E. M. F. at closing is so small that even with the largest coils a spark of only a fraction of a millimetre can be produced; there is a great difference between using direct and alternating currents in the primary, the output of the apparatus being much greater by using the latter, the efficiency being also much greater, but the frequency required to produce the equivalent of a direct current is far greater than those usually used in practice, and it is therefore necessary to increase the current; he shows that the condenser ought to be as small as possible, and discusses its effect and the calculation of it, concluding that the best way to adjust it is by experiment; the true action of the condenser is not to counterbalance completely the self-induction of the bobbin, as is sometimes stated; theory and experiments accord in the case of small coils, but not in the case of large ones.

Measuring the Difference of Phase.—In a paper by Mr. Hess, reprinted in "L'Ind. Elec." March 25, he describes a method in which each of the two currents is made to create a turning magnetic field; if the currents have the same amplitude and the fields turn in opposite directions, there will be a resultant if both act on the same point, from the inclination of which the difference in phase can be determined; the resultant is indicated by means of a small needle of soft iron.

Rapid Verification of Meters.—The article by Mr. Picou, abstracted in the Digest April 7, is reprinted in abstract in the Lond. "Elec. Rev.," March 30.

ELECTRIC RAILWAYS.

Heilmann Locomotive.—The article by Mr. Haubtmann is concluded in "L'Elec.," March 24. The two causes for the inferiority of this locomotive are the small power furnished by the steam engine and the enormous weight of the whole locomotive; it was found that the steam engine was much too small in proportion to the boiler, a defect which was discovered too late to be remedied, but even if it had been equal to that of the boiler, there would have been only 750 to 800 h. p. at the wheels, corresponding to a velocity of about 42 miles per hour, which is accomplished daily by ordinary locomotives with a train of double the weight; but even if the steam engine was equal to that of the boiler the whole locomotive would do but 50 per cent. of the work of the Bousquet locomotive; it is therefore quite inferior to present locomotives; it would be difficult to construct such a locomotive at 198 to 220 pounds of dead weight per horse power; certain locomotives at present in use give 1,100 h. p. with a weight of 80 tons, or about 151 pounds per horse power, which it would be almost impossible to arrive at with an electric locomotive of this kind; for the same useful work the power of the electric locomotive would have to be increased 25 per cent. above that of steam locomotives. Tables are quoted from the recent paper of Mr. Bousquet, giving the calculated weight and horse power for a series of speeds for locomotives of different weights per horse power for draw-

ing a train of 100 tons up a 5-per cent. grade, showing that the weight and horse power become infinitely great at speeds of 84 to 120 miles per hour, the latter being for a weight of 77 pounds per horse power (it seems doubtful whether these figures are perfectly reliable, in view of the high speeds which have been arrived at in this country with steam locomotives).

Mr. Lea, in the Lond. "Elec. Rev.," March 30, in reply to the recent editorial in that journal, thinks that due justice was not done to the capacity of the motors for operating in series when starting and in parallel when the normal speed is attained; he also calls attention to the fact that a high speed service is essentially one of few stops, implying that the starting is not such an important factor.

Budapest Conduit Road.—The conduit road in the city of Budapest is said to be one of the most flourishing in Europe, and its rapid development shows that such systems can, under certain conditions, give very economical results; in 1893 12.5 million passengers were carried, the receipts being $500,000, enabling a dividend of 8 per cent. on a capital of $2,000,000 to be paid; the number of cars has now been increased to over 100.

High Speed Railroading.—Mr. Behr, in the Lond. "Elec. Rev.," March 30, states that his company is preparing for the construction of a full sized lightning express trial line for carrying out experiments.

Railway in London.—According to the English journals it is proposed to construct an underground electric railway from near the centre of London to Hampstead, a distance of about five miles; a two and a half minute service is proposed, seating 200 passengers per train.

Early Invention of the Overhead Method.—"L'Ind. Elec.," March 25, reprints a French patent recently found by Mr. Tanner, to a Mr. Boue, dated Sept. 17, 1878, No. 126,446, in which he describes a system of electric railways in which the current is received by means of a trolley traveling on an overhead line, returning by means of the rails; the illustrations are reproduced; the grooved trolley wheel is shown carried by guides in the form of rollers traveling on overhead guide rails; in addition to the trolley there are metallic brushes; to the combination he gives the name of sliding wheels.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Parallel Working of Long Lines.—The discussion of Mr. Mordey's paper is continued in the Lond. "Elec. Eng.," March 30; Major General Webber cited a curious instance in one of the London stations in which a Mordey 100-kw. machine driven at 167 revolutions was coupled with a Thomson-Houston 130-kw. alternator driven at 170 revolutions, the two machines being in different stations 7,500 feet distant from each other; they had been worked in parallel more than a year very successfully. Prof. Ayrton claimed that the usual methods employed for synchronizing alternators were cumbersome and useless; he showed how easy it is to gauge the exact moment of synchronism by putting the test appliance on the high pressure side, and advocated the use of an ordinary electroscope like the common gold-leaf type; this is connected to the two machines, the foils being connected to one and the container to the other, a very fine conducting wire being also used to join the two machines direct; the period of divergence becomes slower and slower, until at synchronism it is zero. Mr. Mordey, in replying, stated that he agreed with Mr. Kapp as to the margin of power (see Digest last week), but did not think it ought to be obtained by the use of devices which prevented machines from doing work.

Balancing a Three-Wire System with Only One Machine.—The discussion in the Lond. "Elec. Rev." is continued by Mr. Seaman in the issue of March 30, in which he says that the principal drawback to the Edgcumbe arrangement is the difficulty which would be experienced if there was a wide difference of charge between the two halves of the battery; it could be regulated to prevent one-half from being discharged, but only by the expense of a waste in the other half; he has used a balancing machine without any battery at all; in case of further adjustment of potential than that given by the machine, he suggests an arrangement shown in a diagram, in which the battery can be either charged or discharged.

Crane.—According to the Lond. "Elec. Eng." March 30, calculations based on a series of tests, with a weight somewhat less than a ton, show that the efficiency of the electric jib crane used in Pimlico on the Thames is 78 per cent.; the maximum lifting power is three tons; its capacity is 200 tons of coal per day (but the weight is not given).

Gas Engines and Accumulators.—A translation of the article mentioned in the Digest Oct. 7, together with some illustrations, is given in abstract in the Lond. "Elec. Eng.," March 30.

Key.—In the Lond. "Elec. Rev.," March 30 Sir David Salomon suggests placing a small piston and spring in the hole of keys used for turning on street lights, in order to prevent the key from being left in the switch.

Brussels.—The English journals of March 30, give illustrated descriptions of this station, in which the three-wire low pressure system is used in conjunction with accumulators.

Morton's Steam Turbine.—The Lond. "Elec. Rev.," March 30, gives an illustrated description; the steam passes through the circumference of successive rings placed one inside of the other; several good illustrations are given.

Refuse Destructor.—"Ind. and Iron," March 30, contains an illustrated article, with tables and data, of the Livet destroyer.

Testing of Engines and Boilers.—The Lond. "Elec.," March 30, reprints at some length a lecture by Prof. Kennedy on boiler testing.

WIRES, WIRING AND CONDUITS.

Rules for Ship Lighting.—In the concluding section of Mr. Kennedy's serial in the Lond. "Elec. Rev.," March 30, he gives the modifications and alterations which he suggests to be made in those suggested in Lloyd's Register and reprinted in Jamieson's "Rules and Tables." Regarding dynamos, he suggests that ironclad dynamos and motors may be used closer to the compasses than a limit of 30 feet; the compasses should be adjusted with the dynamos and motors at rest; any defections due to the dynamos should be remedied first, and after that any due to the currents; paragraphs 2 and 3 are to be erased; in paragraph 6, under section IV., he adds that in places exposed to weather, oil, steam, water or heat, as also cargo spaces, coal bunkers or spaces which may at any time be used for cargo or baggage, or which are not at all times accessible, the leads must be thoroughly protected by lead covering, galvanized iron wire, armoring or concentric return metallic covering, no wood casing being allowed; wood casing may be allowed in dry places not included in the above; paragraphs 7 and 8 are to be erased; to paragraph 10 he adds that the back blocks containing the contact terminals must be of iron or other unbreakable material and should screw down perfectly watertight; regarding the joints in branches, he states that for main branches and all branches in damp places as specified above, they must be incased in watertight metallic junction boxes or by plumbers' joints; joints in small leads in dry places may be protected by wood casing only, but the joints must be watertight; joints with the hull are to be allowed with concentric wiring, in which system the outer conductor may be grounded; single wiring without concentric returns shall not be allowed, nor the hull alone be used as a return; in damp places metal case switches and fuses should be used,

and they must be perfectly watertight; in petroleum-carrying vessels lamps should be fitted in large groups with the smallest number of switches possible; small fuses from 1 to 5 amperes must be of such a type that a larger fuse cannot be inserted into the cut-out than that for which it is made, and the amperes for which the cut-out and fuse are made should be clearly printed or stamped on both. It is claimed that these rules leave the choice of several good systems, but prohibit jerry wiring; he claims that concentric wiring is not expensive, and watertight junction boxes are just as cheap as others; he prefers the ironclad type of dynamos; he suggests that the alternating system may be the best; for engines he prefers the steam turbine or single acting inverted vertical engine. In an editorial discussion, in which nothing new is given, it is stated that the rules are admirable in most respects, except that they entirely exclude single wiring and that they offer a fairly sound basis on which to form a set of rules.

Explosions in Conduits.—The report of Prof. Kennedy on this subject is reprinted in the Lond. "Elec. Eng.," March 30, and concludes with the following recommendation: the boxes (manholes) should be carefully examined periodically by means of gas detectors; the cover should be completely sealed; if the gas comes through the bottom of the box it should be covered with cement; to ventilate them by connecting them to a chimney and thus reducing the air pressure he thinks is a mistake, as that would draw in the gas; forcing air into them he claims has the drawback that the gases would be sent through the tubes into the houses; he thinks the most practical method of ventilation is to ventilate individual boxes by pipes carried up the sides of adjacent buildings.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Electric Fog Signal.—The Timmis & Abernethy system is described and illustrated in the Lond. "Elec. Eng.," March 30; the position of the signal arm is indicated on the locomotive and in the cabin by electric bells.

ELECTRO-CHEMISTRY.

Purification of Sewage.—"L'Elec.," March 24, publishes an article by Mr. Vitoux, describing the Hermite process somewhat more in detail than in former descriptions, some of the dimensions of the apparatus being given, as also their capacity. The efficiency as a generator of chlorine is said to be high, corresponding to one gram per ampere-hour. For the city of Paris the cost would be 72 cents per inhabitant per year, while the cost in the method used at present is $1.40; the cost of the installation sufficient for the whole city would be about twelve million dollars. A report of Dr. Piton is quoted from, giving the results of experiments; he gives the number of litres of sea water which can be charged to different degrees with chlorine by the apparatus at the city of Brest (the size or horse power of which, however, is not given); relatively the figures show that more than two and one-half times the quantity can be charged to 0.5 gram per litre than to one gram; he also states as the results of the experiments, that the deodorizing power is perfect, that the liquid has no power to dissolve solid matter, that for sterilizing 150 grams of undiluted sewage 6 litres saturated to one gram per litre are required, 9 of c.5 gram and 12 to 15 of c.25 gram; that in equal volumes it takes five minutes to sterilize this at one gram per litre, that it takes five minutes with the same concentration to sterilize an equal volume of a pure culture of the cholera or typhus bacillus, 10 minutes at 0.5 gram for sterilizing an equal volume of a pure culture of the cholera bacillus, 15 minutes at one gram for sterilizing an equal volume of a pure culture of the bacillus subtilis sporule, and finally that an intimate contact is indispensable, thus requiring some mixing apparatus before the sewage reaches the sewer; in conclusion, he says that it is an excellent antiseptic, destroying very rapidly the most resisting micro-organism, but only under the condition that there is intimate contact with the disinfecting liquid. Mr. Hermite has made experiments on fishes, stating that a species of red fish does not seem to be affected in water mixed with a quarter of its volume of the disinfecting liquid.

Electrolytic Sodium Process.—In the Vautin process, described in "Ind. and Iron," March 30, some of the chief difficulties in the electrolysis of the fused salt have been overcome; he employs a cathode of fused lead which has a great affinity for sodium, which is easily deposited into it; the anodes are arranged at the top of the vat, the cathode of melted lead at the bottom; the latter, when sufficiently charged with sodium, is run off; if caustic soda is to be used it is cooled and put into water, where hydrogen and caustic soda will be formed, leaving the lead in the form of powder; the chlorine is led off into lime chambers in the usual way. This lead sodium alloy is applicable to most processes for which sodium is at present employed, a number of cases being mentioned. The process is made continuous by drawing off the charged lead with a pipe into a second chamber; the diffusion of the sodium in the melted lead is said to be astonishingly rapid; the lead in the second vessel is treated with steam, which produces fused caustic. The action of the chlorine on the iron is prevented by using a mixture of chlorides for the electrolyte so as to procure a low melting point; the iron is dipped into the fused common salt, which forms a protective coating, which does not melt at the ordinary temperature of working.

Electricity in Metallurgical Operations.—Mr. Garnier, in an article in "Comptes Rendus," abstracted briefly in the Lond. "Elec.," March 30, suggests a method by which the process in certain metallurgical operations can be followed, especially those in the refining of metals; the apparatus consists of a tube of refractory material, in which some substance like powdered oxide of nickel mixed with charcoal is placed between two soft steel rods, sealing the tube at both ends, the thickness of the material being a few centimetres; when placed horizontally in a furnace the process in the tube is indicated by the electrical resistance offered by this material.

Electrolysis in Chemical Industries.—In a lecture by Mr. Rideal, reprinted in Lond. "Lightning," March 29, he describes electro-chemical processes for manufacturing iodoform, bromoform, chloroform, indigo and a number of metallic colors.

Aluminium and Platinum Alloy Plating.—An alloy of aluminium and platinum forms a yellow metal, which is very durable and suitable for protecting steel knives, besides forming a substitute for gold plating; in the Darling method, described in Lond. "Lightning," March 29, the bath consists of a solution of sodium aluminate, to which is added platinum cyanide dissolved in an excess of a potassium cyanide solution; the anode of the battery consists of a block of carbon or a sheet of platinum; the deposit has a pale yellow color like gold alloyed with 5 per cent. of silver, and contains only a very small per cent. of platinum, for which reason it is not expensive.

Conductivity of Cupric Chloride Solutions.—The Lond. "Elec. Eng.," March 30, quotes from the "Ann. Phys. Chem.," stating that such solutions show a regularly diminishing rate of increase of conductivity with temperature, that it varies with the concentration and that the maximum conductivity is obtained with solutions containing 18 per cent. of the salt; the temperature coefficient varies with the concentration and reaches a maximum at about 40 degrees (C?).

MISCELLANEOUS.

Wormproof Poles.—According to the "Elek. Tech.," Feb. 28, Mr. Mer states that as the worms eat the starch which is contained in the wood, if the wood is free from starch it will be proof against the worms; to free it from

starch, the trees which are to be cut in the fall should have the bark stripped in the spring for the length of one foot around the whole tree; the tree in its growth will then consume the starch to form the leaves, after which it will die, leaving the wood free from starch.

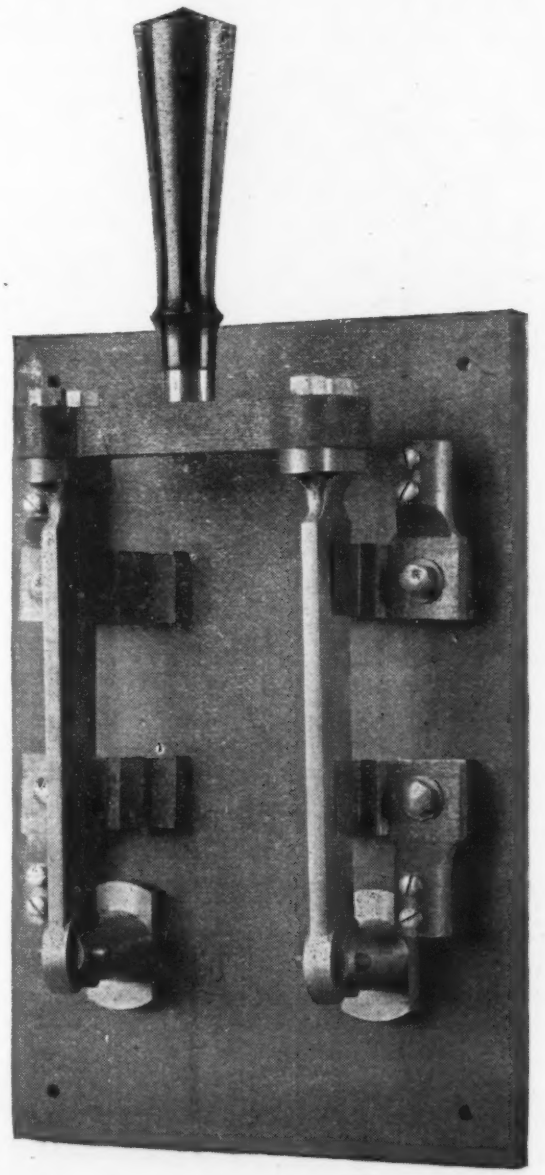
Electrical Treatment of Infantile Paralysis.—The Lond. "Elec. Rev.," March 30, reprints a paper by Dr. Jones on this subject, recently read before the Medical Society of London, in which he describes the successful treatment in a number of cases.

Electric Clock.—"La Nature," March 17, describes and illustrates a simple form of electric clock operated by a battery and an arrangement similar to the Hipp movement.

Commercial Progress of Electricity.—An article on this subject by Major S. Flood Page in the Lond. "Times" is reprinted in the Lond. "Elec. Eng.," March 30.

Double Pole Switch.

The switch illustrated, manufactured by N. S. Large & Son, 321 Chestnut street, Philadelphia, is made in sizes from

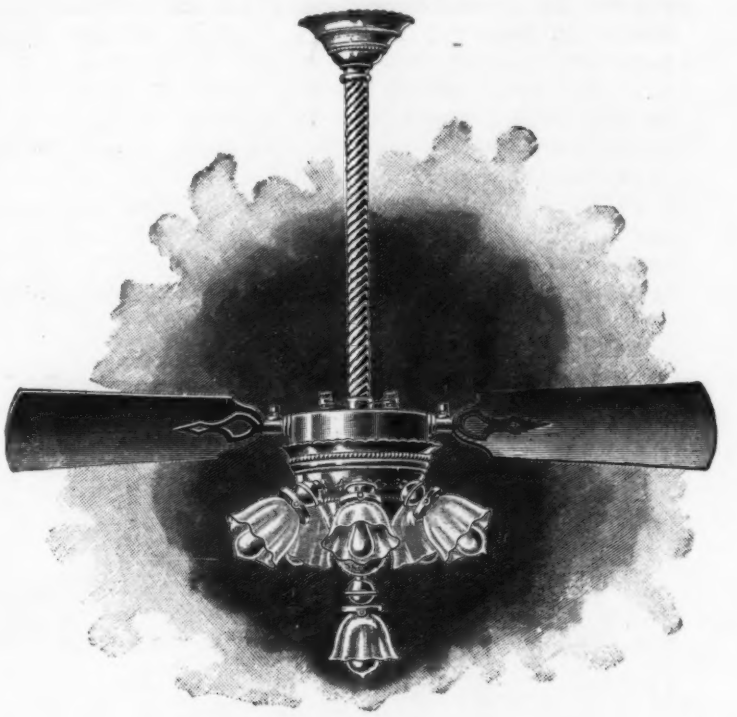


DOUBLE POLE SWITCH.

40 to 600 amperes, both dipped and polished, and with or without fuses. All parts of the switch are well proportioned, the contacts being of large area and taking a firm hold on the blade. The same style is also made in single and triple pole.

Combined Fan and Electrolier.

The combined fan and electrolier illustrated, manufactured by Diehl & Co., Elizabeth, N. J., is a neat combina-



FAN AND ELECTROLIER.

tion that will be appreciated during the summer months. Both lights and fan can be operated together or separately, as desired, and the blades are detachable, so that their presence may be dispensed with during the winter.

The Warren Engine-Dynamo.

We illustrate a combined engine and dynamo now being placed on the market by the C. C. Warren Electric Company, 307 Dearborn street, Chicago, Ill., which possesses a number of points of interest.

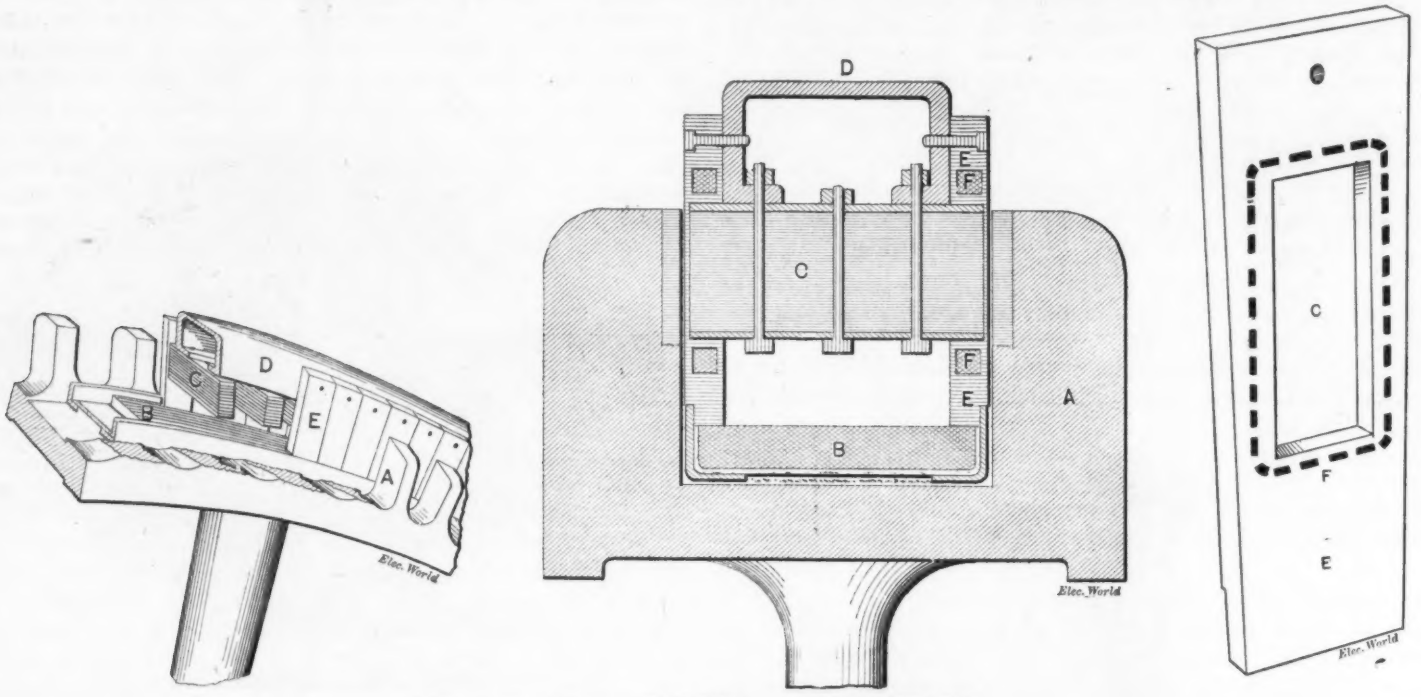
In most engines nearly or quite enough metal is used in the rim of the flywheel to serve for the purposes of the field core or magnetic part of a dynamo whose output in electrical energy is equal to the power developed by the engine. In the dynamo illustrated, the iron of the engine flywheel is utilized for the field and the pole pieces of the dynamo. Nothing revolves but the iron of the flywheel; there are no commutator, collecting rings, brushes, nor any current carrying apparatus whatever that is in motion. It is claimed that with this engine-dynamo not only is a duplication of iron for magnetic use avoided, but the power usually lost in belts, countershafting, etc., is saved, as well as valuable space; and that the cost of labor in the operation of the station, the first cost of the plant, and wear and tear are all reduced.

The illustration shows a tandem compound engine, which runs at a speed of 134 revolutions per minute, and around whose flywheel is built a 200-kw. alternator capable of operating 4,000 50-watt incandescent lamps, exclusive of line and transformer loss. The entire space required for this 4,000-light plant (exclusive of boiler room) is 15 feet by 35 feet, which allows ample space all about it. The alternator illustrated is adapted to any voltage, and may be changed from high to low voltage, or vice versa, by simply changing the stationary armature coil connections, no new part or parts being required in making such changes. It may be used as an alternating current arc lighting machine, or its circuits

may be divided and arc lights operated on one portion and incandescent lamps on the other.

The construction of the rim of the flywheel is shown in Figs. 2 and 3. The polar projections, *A*, are laminated next to the armature coils in order to prevent heating. A sufficient amount of metal is provided in the rim and polar projections to keep the maximum magnetic density within 40,000 lines per square inch. A metal satisfying this requirement is obtained from a mixture consisting of one part Lake Superior iron, one part Pittsburgh or Southern iron, and one part Swedish iron, with one pound of aluminium to each ton of the mixture. The following are the dimensions of the flywheel: Diameter, 15 feet; width, 30 inches; thickness, 4 1-4 inches; radial length of polar proection, 11 1-4 inches; sectional dimensions of same, 3 × 7 inches; number of same, 112; weight of rim, 18,500 pounds; weight of polar projections, 80 pounds each; total weight of wheel, 36,360 pounds.

The field magnet, *B*, is shown in Figs. 2 and 3. Two angle iron rings are secured to the stationary support, *D*, which also carries the armature cores and coils. The magnet wire, *B*, is wound on 1-4-inch fibre board, which rests on these two angle irons. The least and greatest diameter of the completed circular magnet is 15 feet, 1-2 inch and 15 feet, 8 1-2 inches. The weights are: Iron rings, 440 pounds; fibre, 135 pounds; magnet wire, 3,700 pounds.



FIGS. 2, 3 AND 4.—WARREN ENGINE-DYNAMO.

The armature cores, *C*, are also shown in Figs. 2 and 3 and are attached, as shown, to the hollow stationary support, D, a full view of which is had in Fig. 1. The cores are stamped from No. 28 or 30 rolled plates, and each lamination is insulated with manilla paper and the bolts insulated by means of fibre tubes. The weight of the laminated iron in the cores is 5,915 pounds, of the paper, 253 pounds, tubing, 22 pounds, the entire weight being 7,460 pounds.

Fig. 4 shows a complete armature coil, the windings being indicated by the dotted line. The magnet wire, *F*, is wound into shape on a form and then bound together with insulating tape to enable the coil to be handled without losing its

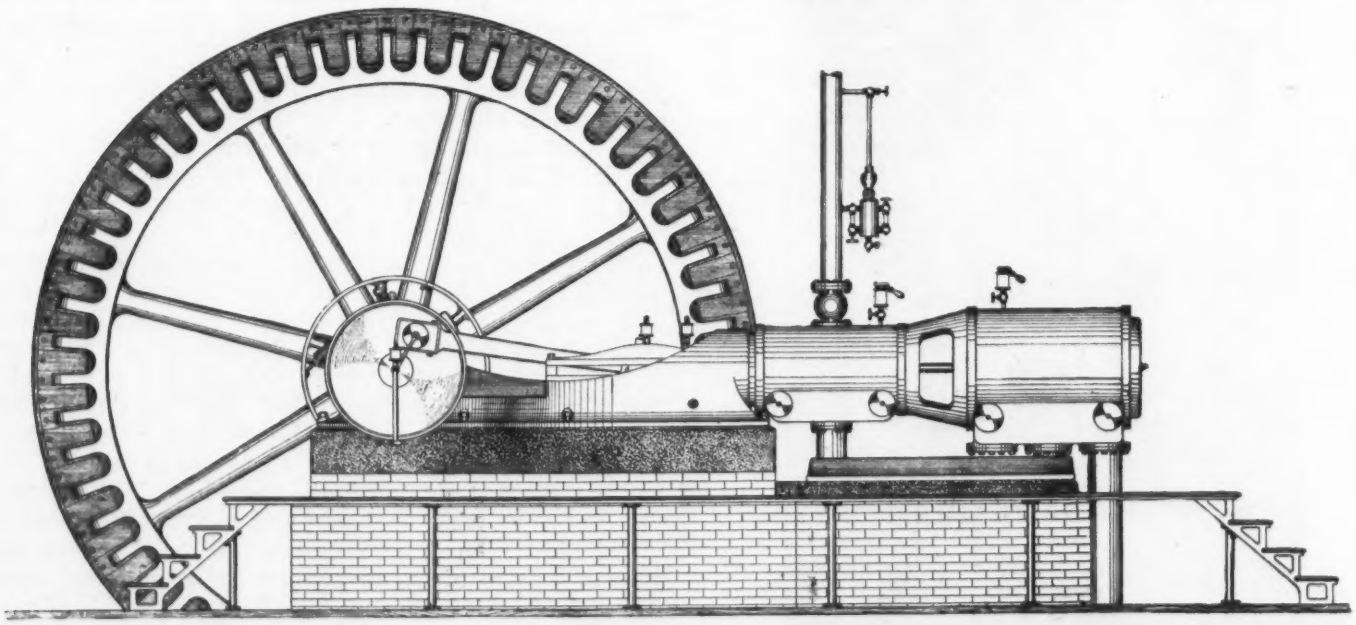


FIG. 1.—WARREN ENGINE-DYNAMO.

shape. The case is made of specially prepared fibre, which is readily moulded to any shape. The case, *E*, is attached to the supporting ring, as shown, and fits on the end of the armature core, *C*, the lower end fitting in the rims of the field coil support. The back portion is recessed to within 1-4 inch of the front surface, in order that a smooth appearance may be given to the machine and also to strengthen the lower part of the case. The weight of 224 fibre cases is 450 pounds, and that of 224 coils is 933 pounds.

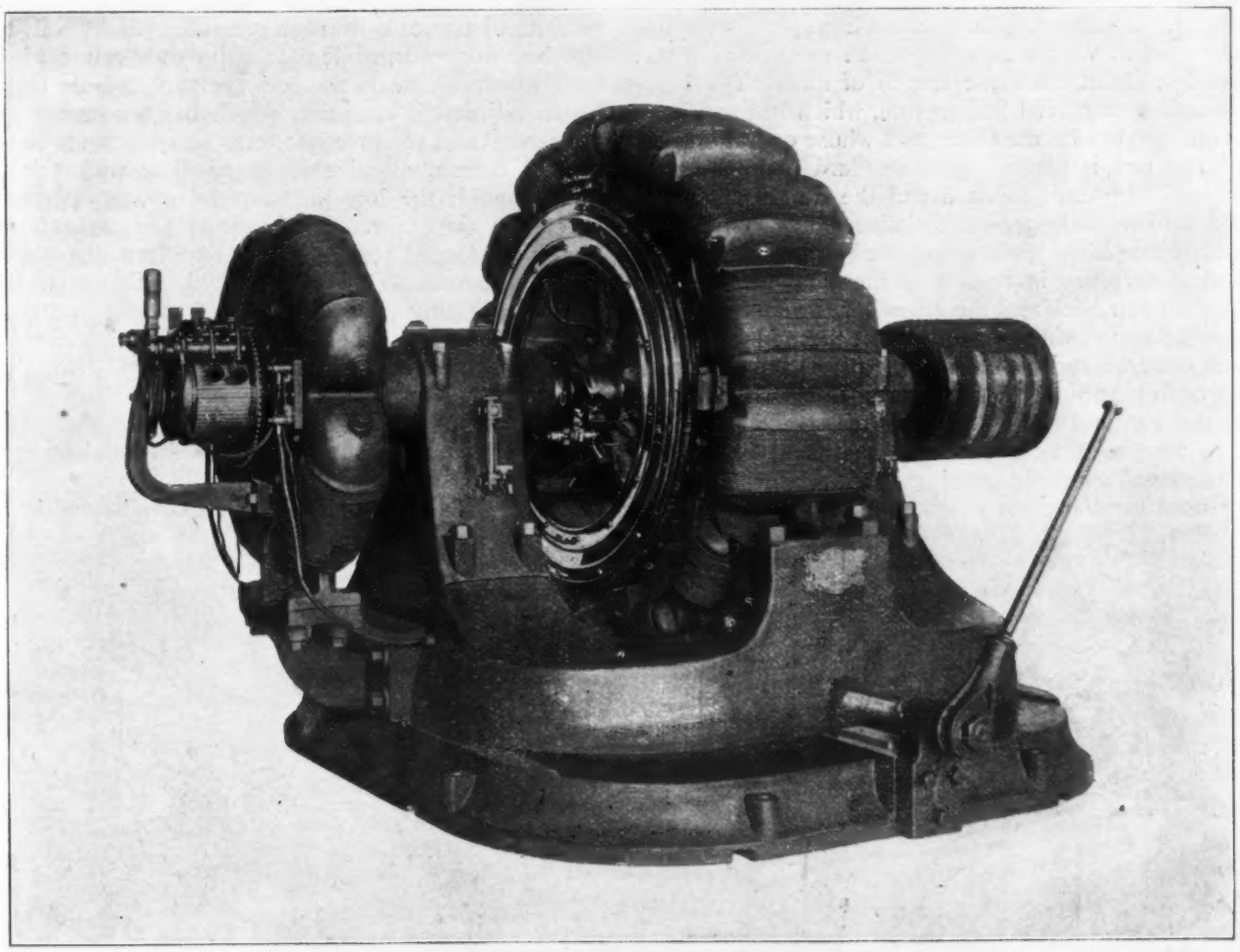
The stationary supporting ring, or frame, to which are attached the armature cores and cases, and field magnet coil, has the two inner flanges surfaced concentric with the wheel, and the outer face cored at various places to reduce the weight. The least diameter of the supporting frame is 17 feet, 4 inches, and the greatest diameter 18 feet, 4 inches, and it weighs completed 3,500 pounds.

The entire weight of the dynamo is 53,035 pounds; deducting from this the weight of the flywheel, there is chargeable to the dynamo proper a weight of 29,035 pounds, which is made up as follows: Cast iron, 15,860 pounds; wrought iron, 7,405 pounds; copper wire, 4,635 pounds; insulating material, 860 pounds; bolts, nuts, etc., 275 pounds.

for such a long time, and, like its multipolar generators, is a consequent pole machine.

The spherical winding of the fields permits of a free ventilation of the armature and at the same time removes the field windings, it is claimed, from any inductive influence from the armature. Owing to this design, the poles are much shorter, giving a shorter magnetic circuit, and a gross weight in the machine of about two-thirds of other types for the same output.

The armature is of the surface drum wound type, the two halves of the armature being in parallel. The spider construction of the armature is very strong and substantial, and gives a form of ventilation that has long been recognized as desirable. From the illustration it will be noticed that this machine is entirely self-contained, the exciter being part of the generator proper, inasmuch as it is on the same shaft as the armature, the fields being spread around this armature by a brass bracket fastened to the base of the alternator. The exciter is a small multipolar machine with a cross-connected armature, allowing two sets of brushes to be used, which are 90 degrees apart on the upper side of the commutator.



NEW STANDARD ALTERNATOR.

The machine is furnished with self-oiling bearings, using two rings for conveying the oil from the reservoir to the shaft above. A glass oil gauge is attached to each journal protected by a brass shield to protect the glass from breakage. The generator is mounted on an iron sub-base provided with a right and left hand ratchet, which can be attached to either end of the machine as desired.

Mr. Woods has now perfected, in connection with this alternating machine, a new type of transformer, the principal features of which are that it is fireproof inside and weatherproof outside, and also a complete line of measuring instruments, both new and novel in design.

The Standard Alternating Current System.

We illustrate herewith the new alternator of the Standard Electric Company, of Chicago, which has just completed its new alternating current system after a year's experiment conducted by their electrician, Mr. C. E. Woods. The generator shown has a capacity of 1,250 lights. It operates at 1,100 volts and 60 amperes, has fourteen poles and revolves 1,070 times per minute with 15,000 alternations. The general lines, or contour, of the machine is the same as that of the series arc lighting dynamo made by the same concern

Improved Tandem Compound Engine.

The M. A. Green automatic cut-off engines, manufactured by the Altoona (Pa.) Manufacturing Company, have established a deservedly high reputation, and in this issue we illustrate the tandem compound type, which is particularly interesting.

By an examination of the cut it will be noticed that both pistons can be as easily removed and with as little work as that of a single cylinder engine. All that is required is to remove the low pressure cylinder head and the nuts from the studs which hold the intermediate or packing head in position, they being on the outside between the two cylinders, when both piston rod and intermediate head can easily be drawn through without any disturbance to any part of the valve gear or removal of cylinders; it is not necessary to remove the low pressure piston head from the rod at any time.

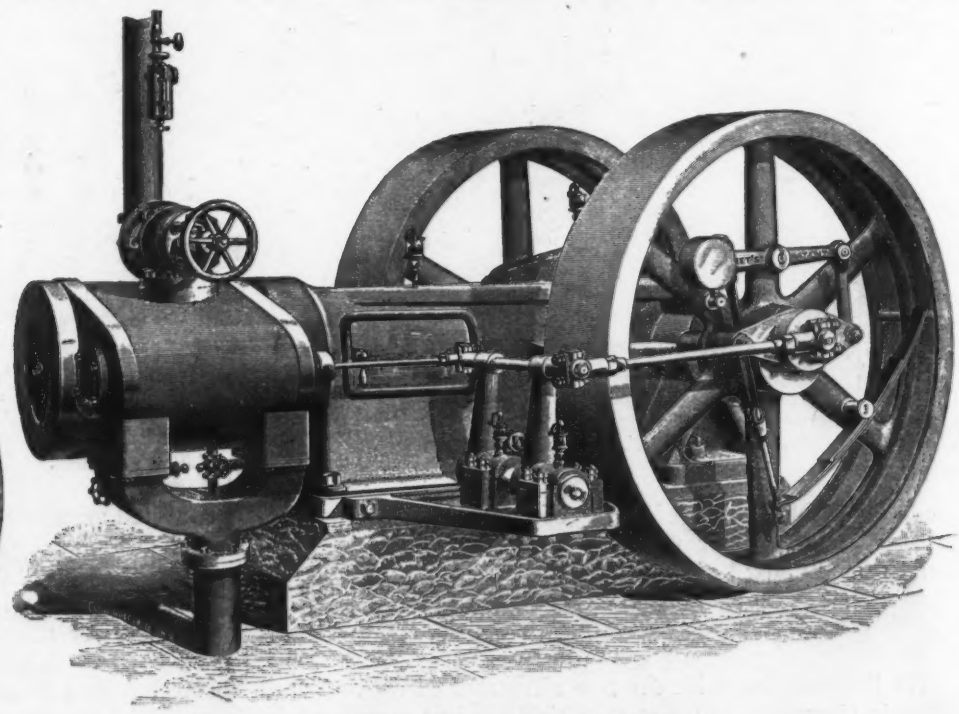
Another valuable feature is that there are no stuffing boxes between the two cylinders. The packing that is in the middle head is a newly designed double metallic packing, which will last from four to five years and require no attention whatever. The stuffing box on the high pressure cylinder is also packed with a new improved metallic packing, which will last about the same length of time. The bearings are bored by a special boring mill, which has two bars, one at a right angle with the other, and whose operation is as follows: The bed is placed upon standard parallel strips, the main bar is brought forward and the frame turned off and bored, and also the guides finished at the same time. The points of the pillow block are spotted with the main bar, thus securing accuracy in regard to the centre alignment; the bar is then run back and the cross bar brought forward, which passes through the main bearings; these bearings are then bored out true and the inner edge of the pillow blocks faced off true in keeping with the spotting that has been done by the centre bar, and the outer edges of the pillow blocks brought to length in keeping with the inner edge. The bed is then placed upon the erecting block. Special babbitt shells are used for the main bearings. The centre core of the mould for casting the shells is increased a fraction in diameter over that of the shaft, and the outer shell of the mould is also a fraction larger. By this method allowance is made for the natural shrinkage of the babbitt shells, so that they may absolutely fit the main bearings on the outer and inner diameters, requiring no spotting or fitting. The smooth surface on the babbitt is thus retained as it comes from the moulds, as experiments have shown that the surface or skin produced on the babbitt by casting them in smooth moulds wears much longer and smoother than if that portion of the babbitt were scraped off.

The governor of this engine will, under wide variations of load, regulate within 1 per cent., and much closer if desired. The parts of the governor have anti-friction bearings, which do away with the annoyance of oil. The main bearings also have oil receivers, which return any drippings of oil back into a reservoir in the bed. The discs are completely covered with a hood, so that the engine is absolutely free from the annoyance of throwing oil.

The valve is remarkable for its simplicity and ease of operation, being as perfectly balanced as a piston valve and at the same time is at liberty to leave its seat, even more easily than an ordinary "D" slide valve; for the moment the pressure in either cylinder increases a small percentage over that of the steam pressure, the valve will rise, thus relieving the working order as soon as the pressure has disappeared. It will be noticed that only the high pressure cylinder valve is operated by a governor, while the low pressure cylinder is operated by a governor, while the low pressure cylinde ris operated by an adjustable eccentric, which has a constant cut-off of from one-third to three-quarters. Experiments have shown greater economy and smooth running with this arrangement than if the low pressure valve was operated by an automatic governor. Crank shafts are made from a fine quality of forged steel, and the cast iron discs have heavy counterbalances, so as to thoroughly balance the weight of the reciprocating parts, and are bored true and thoroughly fitted to the arms of the crank shafts by an improved method, which produces a practical fit, bolts or babbitt or similar expedients not being used for this purpose. The shaft is extra large in diameter, and has long bearings; the crank pin is the full diameter of the shaft, and all the bearings are ground true.

The connecting rod does away with bolts and keys on the centre crank engine, enabling an incline block to be used to make the adjustment with one screw. This block being the full breadth of the rod, not only forms a firm backing but admits of nice adjustments. Every part of these engines is interchangeable, being built to standard gauges.

THE GOVERNOR.



TANDEM COMPOUND ENGINE.

The wheels have extra heavy rims with split hubs. This removes all danger of breakage of wheels by unequal shrinkage, and further enables the shaft to be clamped more thoroughly, and the heavy rims insure smooth rotary motion.

New Type of Vertical Compound Engine.

The Corliss engine has been definitely accepted as the type giving the highest economy, and an analysis based upon the principles of steam engineering shows that its economy is chiefly due to two points—correct steam distribution and small clearance space. From the form and position of valves, the clearance is reduced to a minimum, while the wrist plate motion and the releasing gear admit of an ideal control of the admission and exhaust. Unfortunately, however, the Corliss releasing gear limits the rotative speed to 100 revolutions per minute, or even less, and it was to overcome this limitation that the Ball & Wood Co., of Elizabethport, N. J., designed the engine and valve gear which we illustrate, and in which the automatic cut-off is obtained by independently operated cut-off valves placed inside the steam valves and actuated by a specially designed governor. This arrangement places no restriction on the rotative speed, which is decided by other considerations.

As will be seen from the illustrations, motion is transmitted from the engine shaft to a horizontal shaft by means of bevel gearing. One end of this horizontal shaft actuates a Corliss wrist plate, which gives motion to the exhaust and main steam valves. To the other end of the shaft is secured an ordinary Ball & Wood governing wheel. The cut-off valves, which are placed inside the steam valves, receive a motion which is the resultant of that of the horizontal shaft and the motion of the same shaft, as modified by the governor. It may be here remarked that an independent valve shaft, driven by gearing from the main engine shaft, is used with some of the most successful types of torpedo-boat engines, and that, owing to the slight amount of work required to drive the valve gear, the usual objections against the employment of gears do not apply.

The resultant motion given to the cut-off valves is such that they operate at all points of cut-off relatively to the main valves, just as though the latter were standing still, thus preventing wire drawing of steam at any point of cut-off.

The location of the valves in the cylinder head, giving as it does the shortest possible ports, permits of their being of ample capacity without an appreciable increase of clearance. The peculiar motion of the cut-off valve utilizes these wide ports to the fullest possible extent, and the cut-off motion at every point from zero to three-quarter stroke is a rapid one; in fact, as rapid as is obtained from the releasing gear, because of the higher rotative speed of the engine. Another feature of great importance in this gear, particularly with compound engines, or where moments of excessive overload occur, is its ability to cut off at three-quarter stroke, while the Corliss gear is limited to about half stroke. We hope before long to publish a detailed description of the valves and gear, accompanied by indicator cards, and we congratulate Messrs. Ball & Wood on what seems to be a real advance in steam engine design.

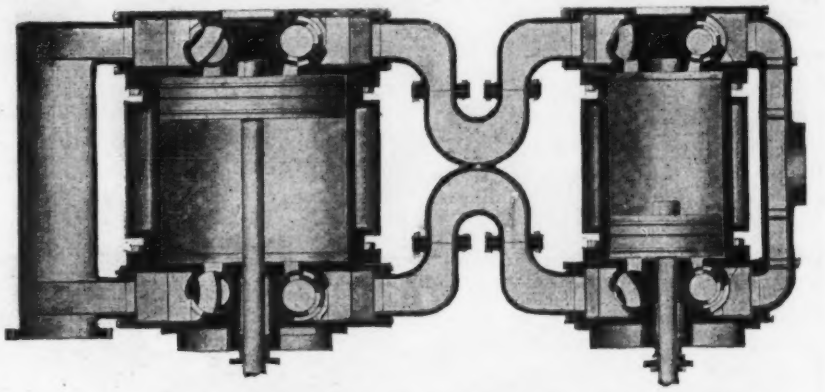
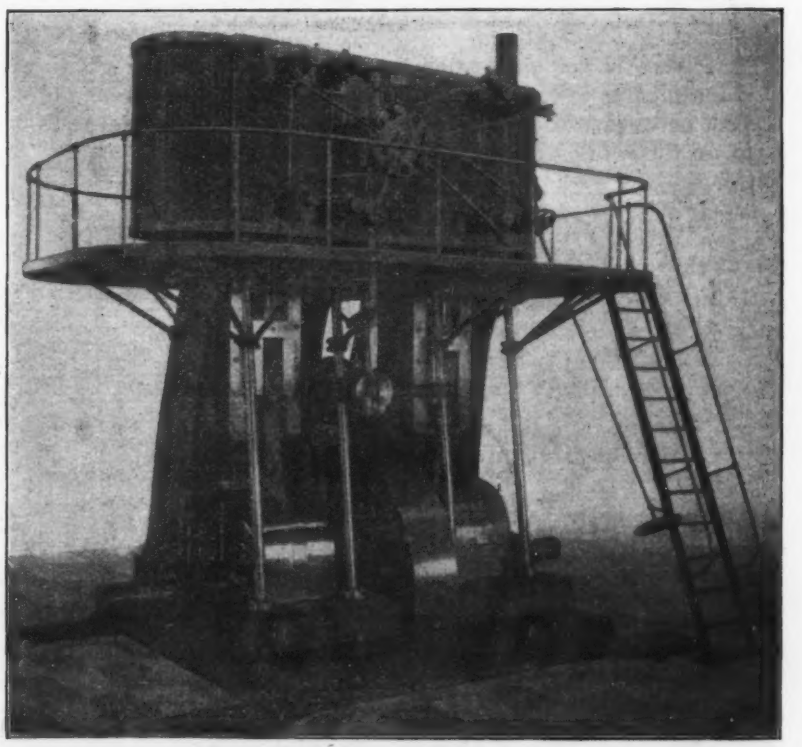


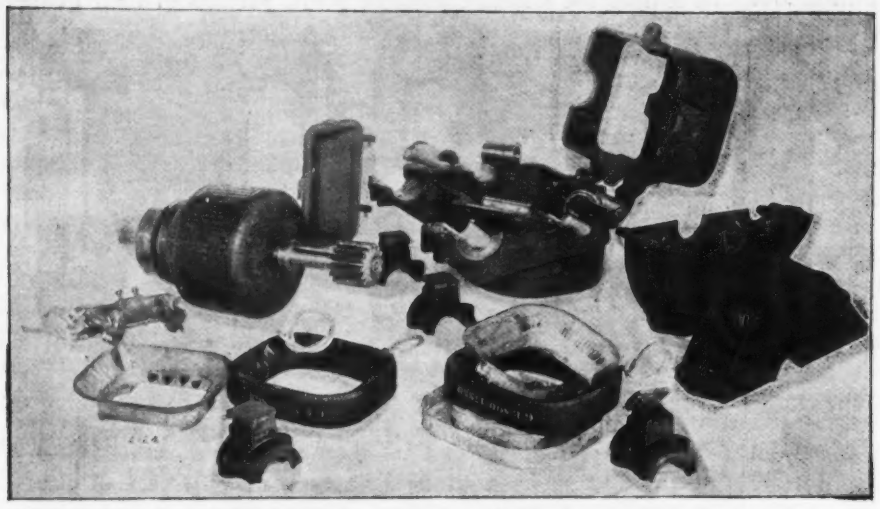
FIG. 3.—SECTION OF CYLINDERS AND VALVES.



FIGS. 1 AND 2.—NEW TYPE OF VERTICAL COMPOUND ENGINE.

General Electric Railway Motor.

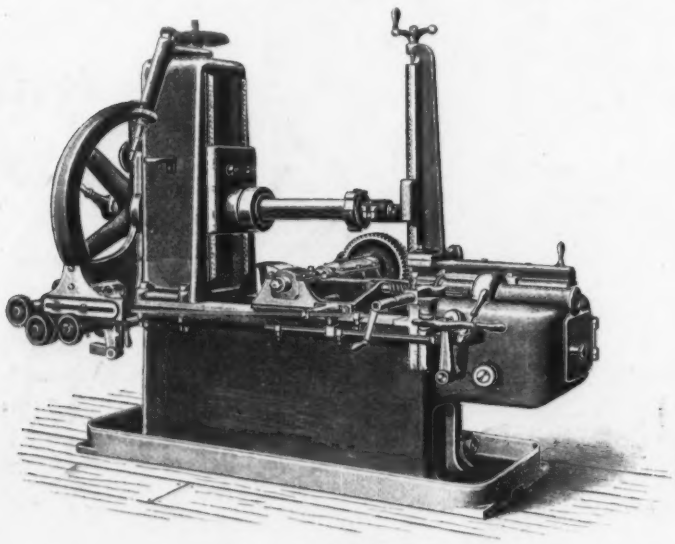
We illustrate below the parts of the General Electric G. E. 800 railway motor, whose light weight and simplicity of construction and manipulation have rendered it a general favorite among street railway men. By its use are claimed a decided economy in track expense and diminished maintenance and repair charges. The armature is of the ironclad type, with embedded winding. The bearings are lined with the best quality babbitt, and the brushes are readily accessible. When the motor is mounted on the axle and closed it is both water and dust proof, and with the type "K" controller is claimed to form an invincible pair.



PARTS OF RAILWAY MOTOR.

Automatic Gear Cutter.

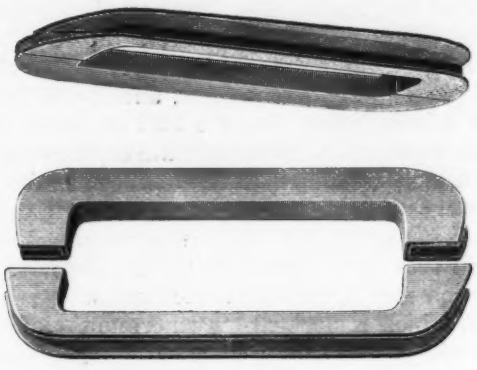
We illustrate below an automatic gear cutter of a new type, manufactured by Gould & Eberhardt, Newark, N. J. The recent development of the electric motor for trolley cars has opened a new field which has made a demand for a machine capable of turning out wheels of about three pitch and with between 60 and 70 teeth and four to five inch face, and to do this work ten hours a day, day in and day out. This machine is so constructed that it turns out from two to three times the number of such gears that could be cut by the machines of the old type, and this without strain to the wearing parts of the machine, all of which are so designed as to be of the simplest form, and most handy for manipulation. The cutters are held in the centre of the cutter slide, so that all wear is equally distributed. In this machine, but two belts are used, one from the main shaft to the counter shaft, and one from the counter shaft to the machine. No belt tightener or cone pulleys are required, variations of speed, and feed as well, being obtained by use of change gears.



GEAR CUTTER.

Armature Spools.

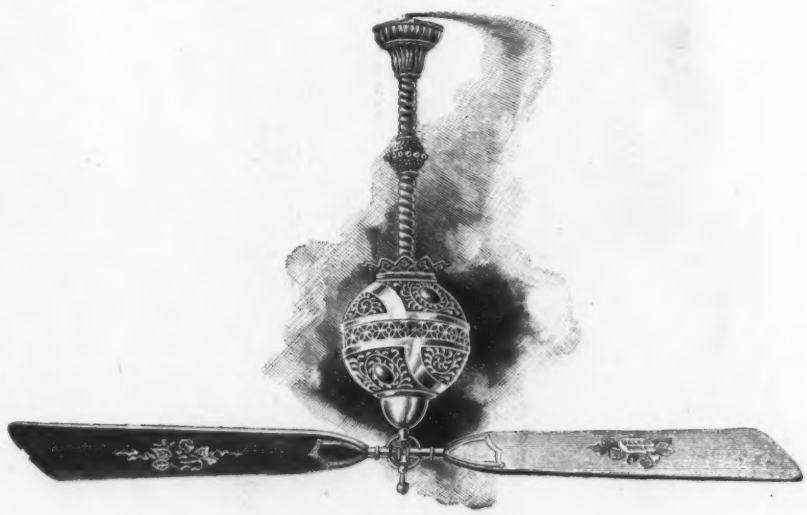
We illustrate a Gramme armature spool recently placed on the market by the Mica Insulator Company, 218 Water street, New York. The material of the spool is micanite, which, as is well known, is made of pure India sheet mica, and, it is claimed, is the equal in intrinsic insulating power to India mica used in sheets, while, practically, owing to its superior strength and moulded form, it is much more substantial and less liable to faults. As shown, the two halves fit into each other and allow the coil to fit snugly on the core.



GRAMME ARMATURE SPOOLS.

Backus Ceiling Fan.

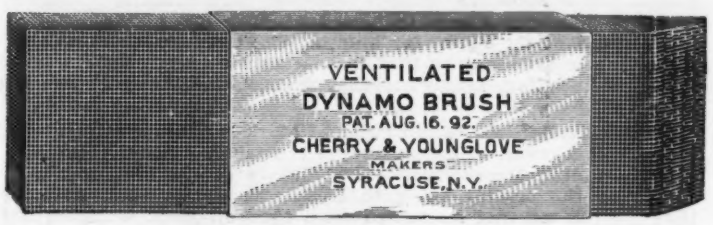
We illustrate a ceiling fan which the Backus Manufacturing Company, Newark, N. J., has designed for the summer season. The motor is wound for 110, 220 and 500 volt circuits, but with the first winding the motor can be used on circuits without injury of a voltage up to 140. The brushes are of imported carbon and are held against the commutator by a light spring; it is claimed that they will last two years without attention or adjustment.



CEILING FAN.

Ventilated Dynamo Brush.

The dynamo brush we illustrate, manufactured by Cherry & Younglove, Syracuse, N. Y., will not, it is claimed, spark, heat or cut the commutator, is flexible, thus insuring a steady current,and it ventilated by the comparatively large openings through it, as indicated in the engraving. The brush is



VENTILATOR DYNAMO BRUSH.

adapted for the ordinary brush holders, and capable of the same adjustment as ordinary dynamo brushes. The ventilating spaces, besides cooling the brush, also, it is claimed, prevent gumming and clogging.

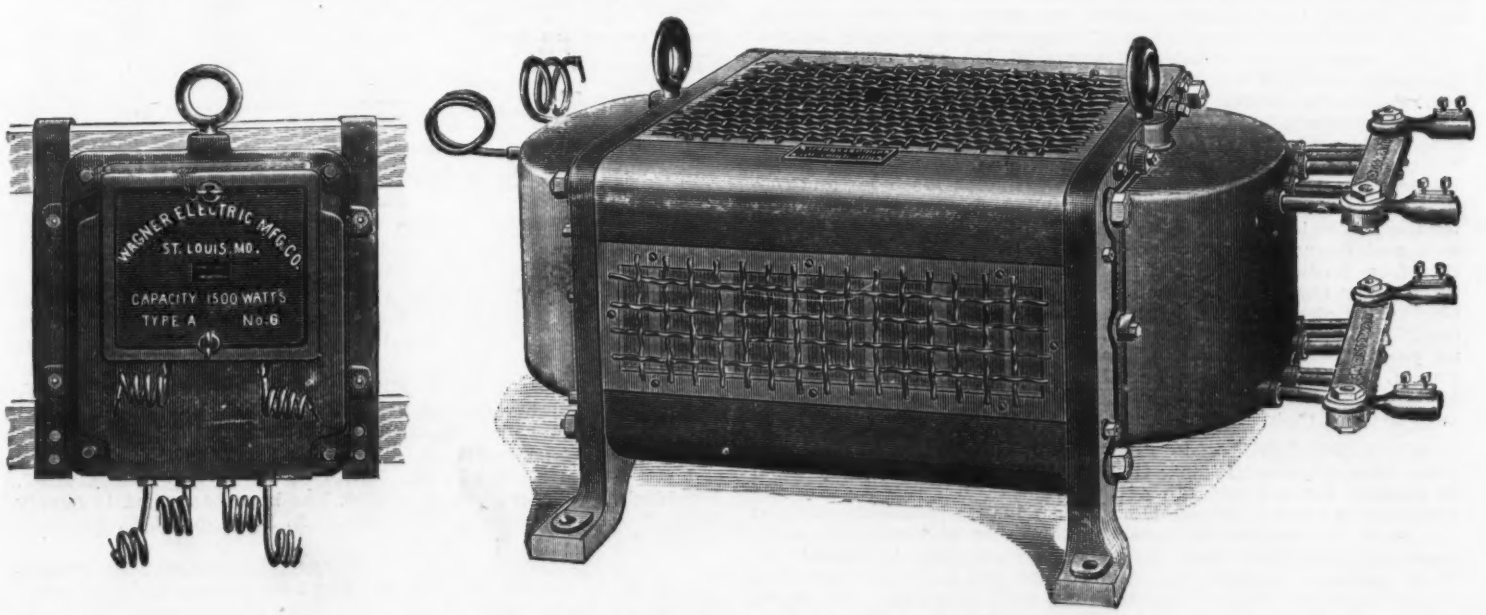
The Wagner Transformers.

The transformers manufactured by the Wagner Manufacturing Company, of St. Louis, Mo., are the result of actual experience in the use of transformers in one of the largest alternating stations in this country, combined with a very careful study of the theoretical considerations involved. Unusual attention has been given to the question of insulation, it having been thought wiser to insulate transformers so that they will not burn out rather than to make the coils removable, thus introducing two or more breaks in the magnetic circuit, with a consequent loss of efficiency. The degree of perfection to which the insulation has been carried is evident from the fact that all ordinary transformers are tested to 8,000 volts, while with step-up transformers this is carried up to 10,000; as a consequence the manufacturers are enabled to give a guarantee against burning out for a period of two years. The same company will also supply transformers with oil insulation, if desired.

Special attention has also been paid to the question of the quantity of magnetizing current,upon hysteresis and eddy currents, great care is taken in the selection of the iron to reduce the first and second, and in the construction to reduce the magnetizing resistance and obviate any eddy currents. The iron used in the transformers is made expressly for the purpose, and is the result of a long series of experiments carried out to determine the best formula for its composition. Owing to the careful selection of the iron and to the skill displayed in the design, the manufacturers are enabled to produce transformers differing from one another in efficiency by a very small amount. The company is, therefore, able to guarantee its transformers not to vary appreciably from the efficiency advertised, which is from 95 to 98 per cent., according to size.

The primary fuse box has been one of the weakest and most troublesome parts of transformers, and some manufacturers have consequently been led to abolish the fuse as part of the transformer, and provide separate boxes for them. The fuse box used with the Wagner transformer, while cast in one piece with the transformer box, is really entirely separate from the interior thereof, there being no opening between the two except the two small holes through which the two primary wires pass. The fuses are mounted on two separate porcelain blocks, rendering a short circuit impossible. These blocks are made in two parts, one being permanently attached to the box and carrying the connections, the other carrying the fuse being held in place against the former by means of simple contact springs; these springs are unusually heavy and will carry 25 amperes without heating. The fuse lies in a groove which forms, when the blocks are in place, a closed tube altogether preventing arcing, when the fuse is blown, and there being no screws nor metal parts of any kind on the outside of the fuse blocks, no injury to the hand could result should the fuse blow while being replaced. The connections with the secondary coils may be made for either 50 or 100 volts, and no fuses are used in this circuit at the transformer.

In addition to the usual types of transformers, arc light and step-up transformers are made, as well as special designs for various purposes, such as regulating transformers for feeders, for station switchboards; transformers to convert constant potential into constant current for series arc or in-



30-LIGHT AND 500-LIGHT WAGNER TRANSFORMERS.

regulation and efficiency. Experience having shown that for the best results in central station practice the drop should not exceed 2½ per cent., that has been made the limit for the smallest transformers, while in the larger ones it does not exceed 1½ per cent. As the leakage current depends upon candescent lighting; transformers for reducing to low potential and large currents for electric welding; reducing and regulating transformers for electro-cautery and surgery, etc. Those illustrated are a 30-light standard transformer for outside use and one of 500 lights for installation inside.

Financial Intelligence.

The Electrical Stock Market.

NEW YORK, April 16, 1894.

GENERAL ELECTRIC especially has been the theme of a deal of discussion. As predicted in these columns for the past two weeks, the present management was re-elected at Tuesday's meeting of stockholders at Schenectady. The managing officials and the board of directors have been held over for another year, except that Mr. Westover was elected to succeed Mr. Garfield as secretary of the General Electric Company. It was also voted to increase the board of directors from 11 to 13, but the two new members of the board will not be elected till later on. But by far the most important action at the meeting had to do with the much mooted question of reduction of capital. Wall Street surmises in this direction have for the once proven correct, and the initiative has been taken by the people most interested in the property, for it was Mr. Charles H. Coster, of the firm of Drexel, Morgan & Co., who made the motion that the board of directors take the proper steps to make up the impairment of capital by providing for the proper reduction in the capital stock. It has been generally agreed that the enormous shrinkage in assets set forth in the annual report has seriously impaired the capital, and, as the only other way to make this up is by assessing the stock, the management is generally agreed that a reduction in stock will be the most practicable way. Under the revised corporation laws of New York State, it is perfectly possible for a corporation in this State to pay dividends regardless of the impairment of capital, but the management is extremely anxious to resume the declaration of dividends, and, if there were less stock, say about $15,000,000, there is understood to be even now a sufficient volume of business to permit of 6 per cent. dividends, even after providing for bad debts and depreciation in subsidiary companies. Of course the average stockholder argues that it is hard to see how the amount of certificates of capital stock outstanding can affect the earning power of a corporation, or how a reduction of such stock is a benefit to the holder. It is further argued that while a stock once issued and distributed may not pay a high percentage of dividends, that is no reason why the holder should be "either forced or misled" into its surrender on the theory that a less volume had more value. This is arguing from the trader's point of view, where the more stock the more are the opportunities for speculative activity. But it is infinitely better that the capital of a company be in keeping with its ability to make money thereon, and, while the remedy proposed is a heroic one, it is the proper recourse for General Electric's ills. Meantime the friends of the property are again becoming enthusiastically voluble in their sentiments regarding the General Electric's future. President Coffin has allowed himself to be interviewed several times at length, and he has been indulging in the most rosy prognostications. He says that there is twice as much work being done at Schenectady as at Lynn, and yet the works are only taxed to one-half, or perhaps two-thirds, of their capacity. The company is doing nothing but a cash business, he says. Some of the valuable patents figured in the annual report's table of assets at $8,159,264 consist, says President Coffin, of the three-wire systems of incandescent lighting, automatic current regulator for arc lights, the Brush company's double arc lamp, feeder patents, etc. The street railway patents are in process of adjudication, as they are being infringed upon, but the company eventually hopes to firmly fix its rights to them. Insiders are, therefore, very bullish on the stock just now, and say that the more the annual report is studied, the better the outlook for the future is considered, as it is clear that the company's business and finances are now on bedrock. Much higher prices are therefore predicted. It might be well to note here that no extraordinary changes have been noted in the stock list. It showed about 4,800 shockholders, 2,800 in Boston and 2,000 in New York; the New York holdings, however, aggregating the larger. While no particularly large holdings are recorded, Drexel, Morgan & Co., H. McKay Twombley, Lee, Higginson & Co., and other large holders have not reduced their lines, although it is well known that very little of their own stock is recorded in their own name.

WESTINGHOUSE ELECTRIC issues, both preferred and common, have advanced rapidly this week. Very little has developed to account for the strength of these stocks, but recent favorable comment is having its effect, and the advance is but the natural result of the company's increasing business and excellent management. Earnings thus far this year are said to exceed the most sanguine official expectations, and the annual report soon to be issued will make a surprisingly good showing. One result of this good feeling has been noted in Boston, where General Electric has been sold around 40 to be converted into Westinghouse common around 35. Some more recent Boston advices are to the effect that the Westinghouse Electric Company has been obliged to increase its night force on account of its large orders for railway apparatus. Contracts have just been made with the Consolidated Railway Company of New Jersey for all its equipment for 1894, estimated as between 300 and 500 cars. The tests on Mr. Westinghouse's three-rail electric road have thus far been very successful, but it will be about three weeks before the experimental line is ready for a complete testing.

EDISON ELECTRIC ILLUMINATING OF NEW YORK securities, especially the 5 per cent. bonds remarked on before in these columns, continue in high favor with the investing public. The company has just declared a quarterly dividend of 1½ per cent., payable May 1 next, and has made a report of earnings for March extremely gratifying to all concerned. Gross earnings increased $9,649, but operating expenses were so reduced as to result in an increase in net earnings of $16,603. From Jan. 1 to March 31, gross earnings increased $42,882, while the net gain was $45,248. The Brooklyn Edison Electric Illuminating Company makes a similarly fine showing. In March gross earnings were $5,135 ahead of the figure for March, 1893; but there was no similar saving in expenses, so that the net gain was only $1,634. Gross earnings since Jan. 1 have increased $19,664 and net earnings but $10,550.

AMERICAN BELL TELEPHONE stock is again receiving good support as a result of the favorable reporting, without recommendations, to the Massachusetts Legislature of the bill for the increase of the capital stock to $50,000,000. It is said, however, that the bill will not be passed until the anti-stock watering bill, now before the same legislative body, is passed, whereby the company will be obliged to offer the stock to the public instead of to stockholders at par. In this way 150 can be easily obtained by public subscription, and this will give the company a premium on the $30,000,000 of $15,000,000. A dividend of $3 per share will be paid to all stockholders of record on March 31 last on Monday next.

ERIE TELEPHONE stock has been a feature of the Boston stock market this week. It, too, has been profiting by the good feeling on the stock existing for some time. Treasurer Glidden says that the Cleveland division gained 53 new subscribers and the Northwestern 43 in March, and that a large number of orders are ahead. He attributes the increase of subscribers to a general improvement in business in the West, and to the extensive free advertising the telephone business has had of late.

THE COMMERCIAL COMPANY is engaged in laying between Ireland and Nova Scotia what is the largest cable yet made. It will transmit messages at a speed 30 per cent. greater than any cable now in use. The stock of this company is now quoted at 130.

WESTERN UNION TELEGRAPH stock has done very little this week. Speculation in the stock has not been enough to be worth commenting upon.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	10	30
Detroit Electrical Works	10	2	5
Cleveland General Electric Co	—	85	90
East River Electric Light	100	—	65
Electric Con. & Supply Co., pref	15	15	16
" " " com	15	15	17½
Edison Electric Ill., New York	100	103	104
" " " 1sts	—	107¼	107½
Edison Electric Ill., Brooklyn	100	103	104*
" " " Boston	100	115	120
" " " Chicago	100	125	130
" " " Philadelphia	100	130	132
Edison Electric Light of Europe	—	—	3
" Bonds	—	80	85
" Ore Milling	—	10	11
Fort Wayne Electric	—	4½	6½
General Electric Company	100	40½	41
" " " deb. 5's	—	85	86
Interior Conduit and Ins. Co	100	35	50
Mount Morris Electric	—	—	65
Westinghouse Consolidated	50	34	35
" " " pref.	50	51½	52½
Western Union Telegraph	—	84⅝	84¾
American Bell Telephone	—	188	189

*Ex. dividend.

New Incorporations.

THE SPRINGER WATER AND ELECTRIC LIGHT COMPANY, of Springer, N. M.. capital stock $25,000, has been formed by Peter B. Talle and others of that town.

THE SHERMAN PARK AND WESTCHESTER COUNTY ELECTRIC RAILWAY COMPANY has been incorporated with a capital stock of $12,000. For information address E. L. Kalish, 165 Broadway, New York.

THE SOUTHERN NEW MEXICO TELEPHONE COMPANY, Las Cruces, N. M., capital stock $30,000, has been incorporated by Albert B. Fall and others, and will construct a telephone line between Las Cruces and Eddy.

THE BESSEMER LIGHT, HEAT AND POWER COMPANY, Braddock, Pa., capital stock $10,000, has been organized to supply light, heat and power by electricity. A. L. Sailor, C. F. Ellis and Josiah Barrett are interested.

THE PORT RICHMOND ELECTRIC COMPANY, Port Richmond, N. Y., capital stock $50,000, has been formed to supply electricity for light, heat, power, etc. The incorporators are J. F. Emmons, K. P. Emmons and C. T. Barret, New Brighton, N. Y.

THE MOUNT MINSI ELECTRIC RAILWAY COMPANY, Stroudsburg, Pa., capital stock $125,000, has been formed to construct and operate an electric railway in Monroe County, Pa. S. D. Overfield, F. W. Ellenburger and A. B. Batchelder are interested.

THE WELLSBOROUGH ELECTRIC COMPANY, Wellsborough, Pa., capital stock $7,000, has been incorporated to supply light, heat and power by means of electricity to the public. J. M. Robinson, L. Harrison and R. K. Young are the organizers.

THE PEOTONE ELECTRIC COMPANY, Peotone, Ill., capital stock $6,000, has been formed to do electric lighting and other electrical business. H. A. Rathje, J. W. Stocker, J. Fedde, E. H. Fedde and M. Collins are the incorporators.

THE HEIMANN CARBON AND INSULATOR COMPANY, Chicago, Ill., capital stock $500,000, has been incorporated by Soloman Heimann and others to manufacture and deal in long life carbons for arc lamps, insulating compound, insulators, etc.

THE STEVENS INDUSTRIAL STEAM-ELECTRIC COMPANY, Spirit Lake, Iowa, capital stock $10,000, has been formed to build an electric plant to supply light, power, etc. B. F. Stevens, S. Stevens and E. W. Hawkins. of Spirit Lake, are the organizers.

THE WESTERN ELECTRIC BEER PUMP COMPANY, Chicago, Ill., capital stock $10,000, has been formed to manufacture and sell beer pumps, freezing machines, etc. R. H. Rudolph, P. Garhart Dahl, Wm. J. Hellwis and L. G. Kunzer are the promoters.

THE ELECTRIC TOY COMPANY, Brooklyn, N. Y., capital stock $10,000, has been organized to manufacture electrical apparatus, toys, etc. E. S. Boynton, 235 Lexington avenue; R. P. Cole, 582 Warren street, and Thomas Prosser, Jr., 15 Gold street, Brooklyn, N. Y., are interested.

THE LANCASTER AND LITITZ ELECTRIC RAILWAY COMPANY, Lancaster, Pa., capital stock $100,000, has been formed to construct and operate a railway. The promoters are J. S. Graybill, C. F. Espenshade, H. Yeasley, J. Shaul, H. C. Hopkins and S. H. Reynolds, of Lancaster.

THE THOMAS H. CROSBY COMPANY, New York, capital stock $5,000, has been formed to manufacture electrotype and stereotype plates. E. A. Tredwell, 521 Nostrand avenue; D. B. Tredwell, 510 Halsey street, Brooklyn, and J. Pendleton, 780 Park avenue, New York, are interested.

THE LANCASTER AND NEW HOLLAND RAILWAY COMPANY, Lancaster, Pa., capital stock $100,000, has been formed to construct and operate an electric railway in the county of Lancaster. J. S. Graybill, C. F. Espenshade, H. Yeasley, J. Shaul, H. G. Hopkins and S. H. Reynolds, all of Lancaster, Pa., are interested.

THE THIELE CHEMICAL COMPANY, New York, maximum capital stock $1,000,000, has been incorporated to manufacture and deal in chemicals, electrical articles, etc. F. C. T. Thiele, S. Friedlander and Felix Hamburger, all of New York, are the organizers.

THE H. P. TOOL COMPANY, of Kent, Ohio, capital stock $10,000, has been incorporated by W. S. Kent and others to manufacture dynamos, motors and electrical goods; also to erect electric light and power plants.

Special Correspondence.

New York Notes.

OFFICE OF THE ELECTRICAL WORLD,
41 Park Row NEW YORK, April 16, 1894.

THE SAFETY INSULATED WIRE COMPANY, 234 West 29th street, New York City, of which Mr. S. L. Requa is manager, will, after May 1, occupy the large six-story building numbered from 225 to 239 West 28th street.

THE UNIVERSAL ELECTRIC PULL SOCKET AND SWITCH COMPANY, 27 Beaver street, New York, is daily appointing agents for the sale of its sockets and switches, the sales of which are far in excess of expectation, times considered.

SEALED PROPOSALS will be received at the fire department of Brooklyn, 367 Jay street, to noon, April 20, for furnishing 100 miles of weather-proof insulated hard-drawn copper wire. F. W. Wurster is commissioner of the fire department.

THOMAS C. PERKINS, vice president of the Mather Electric Company, Manchester, Conn., as in the city recently, and reported business in a flourishing condition, more orders having been taken in the last 30 days than the old company ever secured in the same time in its palmiest days.

A. D. ADAMS, of the Adams Electric Company, Worcester, Mass., was in the city on Saturday. Mr. Adams has designed a new line of dynamos and motors from 3-10 to 20 kw., and for currents of 115, 230 and 500 volts, all of which embody the latest mechanical and electrical improvements.

THE PAGE BELTING COMPANY, 91 Liberty street, New York, announces that notwithstanding the recent loss of its tannery by fire, it has sufficient stock on hand to enable the manufacturing departments to be kept running until the damage is repaired, and that its business will, therefore, not be interrupted.

MR. JAMES L. ROBERTSON, president of the Robertson-Thompson Company, and a member of the Hine & Robertson Company, 57 Cortlandt street, New York, has started on a three months' tour of the country. The straight line indicator, manufactured by this company, is meeting with deserved success among engineers, and, no doubt, Mr. Robertson will return to New York with many orders not only for indicators, but for other specialties manufactured by Mr. Robertson's company.

THE AMERICAN METROLOGICAL SOCIETY.—In accordance with the vote of the council of the American Metrological Society the annual meeting will be held in Washington, D. C., on Friday, April 20, at 2 P. M. The place of meeting is the Columbian University. Papers of interest are expected. T. C. Mendenhall will report on the International Electrical Congress at Chicago. A. A. Michelson will give an account of his work at the International Bureau (near Paris) in determining the value of the meter in terms of wave lengths of light. The committee on color standards will make an interesting report. Persons interested are welcome at the meetings.

New England Notes.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., April 19, 1894.

THE BOSTON ART BRASS COMPANY has been dissolved, and the business is now continued by Robert McGeorge. The offices are in Boston, Mass.

UPTON, MASS.—An electric railroad from Worcester to Boston, via Milford, and passing through this town, is one of the schemes parties are now agitating.

THE BELL TELEPHONE COMPANY has gained its victory with the Massachusetts legislative committee, a majority having reported favorably upon its application to increase its capital to $50,000,000.

MANCHESTER, N. H.—President Williams, of the street railway, has made a survey of the proposed route of the electric railway from this city to Lake Massabesic. Report says that the line is to be constructed this season.

THE DAY-MOBERG ELECTRIC COMPANY, of Boston, manufacturers of the Jupiter storage battery, has just issued a neat little catalogue and price list, which will undoubtedly meet with appreciation, as it presents in brief form the advantages of the Jupiter battery and the various services to which it is especially adapted.

MR. EVERETT K. DAY, superintendent of the Mousam River Railroad, of Sanford, Me., was a recent visitor in Boston. We met him in the offices of the Brown Electric Company deeply interested in its railway specialties, and it is safe to assume that Messrs. Brown & Reynolds convinced him of their value before his departure.

MR. JOHN P. COGHLIN, of the Columbia Electric Company, Worcester, Mass., was a recent visitor at this office. He reports business as good, and left with us a circular, recently issued by his company, setting forth the merits of the "Columbia" dynamo, as well as the various branches of the electrical business to which his company gives especial attention.

MR. CHARLES E. BIBBER, vice president of the Cutter Electrical and Manufacturing Company, of Philadelphia, whom everybody knows and likes, particularly in Boston, where he resided so long, is at present sojourning in that city for a brief period in the interests of his company, and is receiving a hearty welcome both from a business and social standpoint.

A SPECIAL COMMITTEE of the Boston Board of Aldermen has reported to the main body of aldermen a sweeping order that the West End Street Railway Company shall place all feed and return wires in a certain prescribed district, including most of the business section of the city, underground. The work is to be completed by Nov. 1, according to the order. President Little says that it will be impossible to obey the terms of the order.

ATTLEBORO, MASS.—The Attleboro, North Attleboro and Wrentham Street Railway, which has been tied up by litigation for some months, will be in operation by the middle of May. The power house, which was partly destroyed by fire last winter, will be immediately rebuilt, and there will also be a new car house of brick. A large force of men is at work repairing tracks and motors. The road will start under a new management, and with a stronger financial backing.

THE LAWRENCE (MASS.) ELECTRICAL SUPPLY AND CONSTRUCTION COMPANY is one of the best known establishments of its kind in its section. It does a good and profitable business and represents nothing but the best of electrical specialties. One of the specialties it successfully displays to its customers and friends is a copy of The Electrical World of date March 8, 1884. over ten years ago, and which Mr. Charles I. Alexander, of the company, preserves carefully as a curiosity. Mr. Alexander has continued as a subscriber to The Electrical World ever since the date above mentioned, and so has Mr. John P. McLeod, of the Edison Electric Light Company, of Lawrence. Both of these gentlemen are "old timers" in the electrical business.

MR. F. S. PALMER, of the Electric Heat Alarm Company, of Boston, has just returned from a visit to Bangor, Me., and St. John, N. B. He carried with him a most beautiful exhibit outfit of the system of his company, and, for completeness, we have never seen its superior. It attracted in both cities the closest attention of business men, and particularly the insurance people, from whom Mr. Palmer expects to obtain such an endorsement of his system as will secure a reduction of rates wherever it may be used. This is one of the important advantages claimed by the Electric Heat Alarm Company for its fire alarm system—that it not only protects fully, but also reduces the cost of insurance. The company has also recently designed a new switchboard ap-

paratus for detecting hot journals, which seems to be perfect in every respect. It is doing an excellent business. The Pullman Company has just doubled its order for its thermostats.

Western Notes.

BRANCH OFFICE OF THE ELECTRICAL WORLD
936 Monadnock Building CHICAGO April 14, 1894.

THE STROWGER AUTOMATIC TELEPHONE EXCHANGE has given a license for the State of Missouri to a syndicate headed by S. Engel, of 46-48 Van Buren street.

THE SUNBEAM LAMP MANUFACTURING COMPANY, of Chicago, is permanently located in the new Chicago Title and Trust Building, 100 Washington street.

THE CALIFORNIA ENGINEERING COMPANY, Monon Block, Chicago, has changed its name to the New England Engineering Company; same officers and same address.

GEORGE L. THAYER, formerly with the Westinghouse company, and later electrician for the Northwestern Railroad, has opened an office at 1439 Monadnock Block, as consulting electrical engineer. Mr. Thayer is well and favorably known, and his future is full of promise.

THE LOUIS K. COMSTOCK COMPANY is the name under which the business hertofore conducted by Mr. Comstock, one of the best known electrical engineers in the West, will be carried on. Its offices will be in the Monadnock Block, and its corps will embrace several of the ablest engineers and electricians in this section of the country.

JOHN R. MARKLE, one of the pioneers of the electrical business, formerly at Detroit, Mich., is now making his headquarters in Chicago. Mr. Markle has some new and interesting enterprises, which he promises to make known in the near future. For the present his friends can address him care of The Electrical World, 936 Monadnock Block.

THE ELECTRIC STORAGE BATTERY COMPANY, having successfully introduced its batteries into Chicago, through Mr. Charles Blizard, general sales agent, has placed the Western agency with Pierce & Richardson, 527 Manhattan Building. Both these gentlemen are favorably known to the entire electrical fraternity, and their success in handling the electric storage battery does not seem to be questioned.

THE WESTERN ELECTRIC COMPANY reports that it has in progress the wiring of the Astor residences at 65th street and Fifth avenue for 2,100 lights. The wiring is all in brass armored conduit of the Interior Conduit and Insulation Company, after the specification of Architect Hunt. The Scribner Building is going up at a record-breaking pace under the guidance of Architect Flagg and Builder Wills. The wiring contract for 800 lights for this building has been awarded to the Western Electric Company.

SARGENT & LUNDY, Western agents for the Crocker-Wheeler motor, have now on exhibition in their show room, Monadnock Block, samples of all the types of motors manufactured by the Crocker-Wheeler company. These include a new and very ingenious fan motor, known as the 1894 type; a Worthington electric pump for house tank service, and electrically operated machines of different kinds, for which they seem to have a great demand, judging from the number of visitors.

Canadian Notes.

MR. JOHN M. ANDERSON, of North Toronto, who is largely interested in the Metropolitan Railway Company, of that suburb, has issued a writ to restrain the directors from selling the Metropolitan's franchise to the Toronto Railway Company, a deal which has been on the carpet now for some time.

THE QUARTERLY STATEMENT of the Hamilton Street Railway shows the earnings for the three months ending March 24 to be $23,537.77. The city's share of this sum is $2,855.47, made up of 6 per cent. of the gross receipts, and $1,443.20 mileage. This is an increase of $141 for the corresponding quarter of last year.

APPLICATION FOR INCORPORATION by letters patent has been made by the Packard Electric Company, of Montreal. The headquarters of the company will be in that city, and the capital stock of the company is fixed at $300,000. Packard Bros., of Warren, Ohio; Howry Bros., of Saginaw, Mich.; A. McKenzie, barrister, of Toronto, are among the proposed incorporators.

THE ELECTRIC INSTALLATION COMPANY, of Chicago, has applied to the finance committee of the London City Council for information respecting the electric railway franchise. A plan of the streets has been prepared and forwarded to the company, and it is expected an offer will shortly be received from them, which, it is thought, will force a fresh one from the London Street Railway Company.

ALDERMAN LAMB has written, instructing the city engineer to report on the cost of a plant necessary to enable the city to do its own electric lighting, and to secure estimates from leading manufacturers in the United States and Canada as to the cost of a plant. The contract for street lighting now in force with the Toronto Electric Light Company expires in October, 1895, and Chairman Lamb thinks that the city should move at once in the matter. It now costs the city $107,774 per annum, and Alderman Lamb thinks the service could be supplied for very little over one-half this cost.

AN INTERESTING STATE OF AFFAIRS has developed in regard to the double tracking of the Niagara Falls Park and River Railway since the agreement was completed between that company and the park commissioners. Surveys, which have been made with a view of straightening out the road, show that the steel towers of the upper Suspension Bridge project four feet into the street, and that the southeast corner of the Clifton projects much more. To straighten the road as desired, it will require the removal of some 30 feet from the corner mentioned of the Clifton House, and the removal of the two bridge towers, at the expense, it is said, of the owners of the same. As to whether the bridge company can be compelled to remove the towers or not is a question which is to be settled in the courts.

English Notes.

TELEGRAPH REVENUE.—Notwithstanding the competition of the telephone, the telegraph revenue in this country continues to increase slowly but surely. For the year ending March 31 last the total receipts amounted to £2,450,000, an increase of £60,000, or 2.4 per cent.

THE CITY LIGHTING.—During the recent severe frost the water mains supplying the central station of the City of London Electric Lighting Company burst, and the boilers were in danger of being deprived of their natural provender. In this emergency the engineer in charge displayed considerable resourcefulness. He wired to the captain of the London fire brigade, asking for the loan of a fire engine. This was promptly granted, and the boilers were kept going by means of the, so-called, water of the Thames, which was pumped into them with the assistance of a steam fire engine. It may be remarked that the City of London Electric Lighting Company, like the Metropolitan Electric Supply Company, has an action pending against it for injury done by vibration arising from the working of its central station engines.

News of the Week.

Telegraph and Telephone.

THE CITIZENS' TELEPHONE COMPANY, of El Paso, Tex., is preparing to install 200 instruments.

HOLLAND, IND.—Dr. H. W. Stock, of Holland, is interested in a proposed telephone line between Huntingburgh and Holland.

HINGHAM, MASS.—The New England Telegraph and Telephone Company has asked permission to extend its lines and erect new poles, and the Board of Selectmen have taken the matter under advisement.

Electric Light and Power.

WELLS, MINN.—The matter of electric street lighting is being discussed.

THE DUBLIN IRON WORKS, Dublin, Ga., wants a small electric light plant.

HAWARDEN, IOWA.—The matter of electric street lighting is being discussed.

DELL RAPIDS, S. D.—The City Council is considering a proposition for an electric light franchise.

LEXINGTON, N. C.—A joint stock company has been organized in Lexington, N. C., to put in an electric light plant.

SOUTHBORO, MASS.—The Town Council is being urged to take action in the matter of an electric light plant.

THE NATIONAL LIGHT AND FUEL COMPANY, Washington, D. C., wishes estimates for an electric light plant.

NAPOLEON, OHIO.—An election will be held May 14 to vote on the proposed issue of $60,000 waterworks and electric light bonds.

AN ELECTRIC LIGHT PLANT is to be constructed at Liberty, N. Y., and Wolcott & Daly can be addressed regarding the same.

WASHINGTON, PA.—The officials of the local electric street railway company are being urged to extend the line to the cemetery.

THE MOUNT STERLING ELECTRIC LIGHT AND POWER COMPANY, INC., has certified to an increase of capital stock from $7,000 to $12,000.

PARSONS, PA.—Taxpayers are asking the Borough Council to consider the matter of an electric lighting plant, to be owned and operated by the borough.

ROME, N. Y.—The Council will soon call for bids for 150 street lamps to be kept burning from sunset to sunrise, and such bids are to be received for 60 days.

HENDERSON, MINN.—The proposition to bond the town for the purchase of an electric light plant was carried by a large majority. C. Frankenfield is city clerk.

CROTON, N. Y.—Residents are discussing the matter of incorporation for Croton, to the end that they may have improved streets and a street lighting system.

SPRINGFIELD, MINN.—The citizens are in favor of putting in an electric light and waterworks system. The sum of $11,000 in bonds for waterworks was voted last year.

RICHMOND, VA.—The city authorities have received a proposition from a capitalist, whose name is withheld for the present, in the matter of erecting an electric light plant.

RAT PORTAGE, ONT., CANADA.—Sealed proposals will be received till May 1 for lighting the streets by electricity; 22 arc lights are required. J. K. Brydon is city clerk.

MONTCLAIR, N. J.—At a meeting of the Montclair Town Council, the electric light ordinance produced much acrimonious discussion, and the ordinance was finally laid over for two weeks.

MILFORD CENTRE, OHIO.—Sealed proposals will be received to May 11 for the construction of an electric light plant for arc or incandescent lights, as per plans on file. J. G. Bennett is clerk.

RACINE, WIS.—City officials did not accept any of the bids for street lighting. A committee was appointed to make a thorough investigation into the matter of a municipal electric light plant.

HUDSON, N. Y.—The Citizens' Electric Light and Power Company has been granted permission by the Council to erect poles and string wires. Edward J. Hodge is secretary of the company.

PORT RICHMOND, STATEN ISLAND, N. Y.—It is likely that, owing to the strong opposition of Chairman Egbert, of the Village Trustees, the award of contract for electric lighting to Charles A. Ingalls will be reconsidered.

SOUTH NORWALK, CONN.—A resolution has been passed that the city of South Norwalk establish one or more plants for the manufacture and distribution of gas or electricity, and for furnishing light for municipal and general use.

SAN FRANCISCO, CAL.—Mayor Ellert has expressed himself in favor of a municipal electric lighting plant. Expert George P. Low will estimate the cost of wiring the City Hall and constructing and maintaining an electric light plant.

PALMYRA, N. Y.—The Palmyra Electric Light and Power Company will start work on its proposed electric light plant some time this month. The power will be brought from the Littleville plant, which is seven miles from Palmyra.

HAMILTON, OHIO.—The City Council has rescinded all contracts with the several electric companies, and citizens will be granted an opportunity to vote on the proposition to issue additional electric light bonds to the amount of $50,000.

NEW BRIGHTON, STATEN ISLAND, N. Y.—Sealed proposals will be received to 8 P. M. May 1, for the erection, maintenance and operation of a system of street lights for one year, as per details to be had of J. F. O'Grady, clerk of the village.

VALPARAISO, IND.—Edwin Tice and Edgar S. Noe, both of Chicago, Ill., have been granted a 25-year franchise for erecting and maintaining an arc and incandescent light plant and telephone exchange, the plant to be in running order in six months.

CANTON, ILL.—The electric light company is preparing to enlarge its engine power, and it will lower the price for lighting. It will put in for leading merchants from 10 to 16 200-candle power arc lights, and will arrange for residence lighting on an extended scale.

KINGSTON, N. Y.—On account of trouble with the Kingston Electric Light Company, the company has been notified that after April 12 the city will not accept their lights, and proposals are now called for to light the streets and public buildings with electricity, gas or naphtha.

SALAMANCA, N. Y.—It has been found that the contract made by the town authorities with the electric light company is illegal technically, but it is not likely that any changes will be made by either party, provided the company makes certain required improvements.

MARBLEHEAD, MASS.—The selectmen have called a town meeting for Friday evening, April 20, to see if the town will instruct the electric light committee as to the location of the electric light plant, and also to see if the town will reconsider the vote whereby it voted to appropriate $10,000 for the electric plant, to be assessed on the poles and estates this year.

NORTH TONAWANDA, N. Y.—The bill to be presented to the Legislature, authorizing the erection of an electric lighting plant for North Tonawanda, has been completed. It provides that whenever the majority of the village trustees shall deem it advisable they may submit the matter to vote of taxpayers, and in the event of a favorable vote they are to issue 30-year bonds.

SPRINGFIELD, ILL.—The street lighting committee will receive bids, to be submitted to Council, for a municipal electric light plant of 300 lights with 2,000 candle power capacity. For terms address the chairman of the street lighting committee, E. R. Sayler, who will also furnish plans and specifications. The local electric light company has been charging the city $150 per lamp, but has agreed to reduce it to $100, but the Council insists on $80, failing which they will erect a plant for themselves.

NORFOLK, VA.—Prof. L. F. Rodinella, of Philadelphia, has lately completed plans and specifications for an additional dynamo house for the Electric Company of Virginia. The building will be of brick and iron construction, with a frontage of 85 feet and a depth of 56 feet, although the plans provide for extending the latteer to 103 feet when the increasing business of the company demands. The plant will be immediately increased to 750 h. p., supplied by Corliss engines, belted to clutch pulleys on each section of the line shaft, so that any engine can be temporarily thrown out for rest, cleaning or repairs. The line shaft and pulleys are carried in pillow blocks on floor stands, and the arc and incandescent dynamos are so belted to the different sections, that by means of clutch couplings they can be thrown in as needed to supply the varying demands of different parts of the day. Orders have already been placed and work commenced on the foundations.

The Electric Railway.

SPOKANE, WASH.—The Spokane Street Railway will extend its lines.

LA CROSSE, WIS.—The La Crosse and Onalaska Electric Railway Company has increased its capital from $30,000 to $50,000.

SAN FRANCISCO, CAL.—The Market Street Railway officials are discussing the matter of an immense power house at Chamel and Bryant streets.

NEWPORT, KY.—A new electric road will be built from Eleventh and Brighton streets to the Rosedale racecourse. Work will be commenced within 60 days.

NEW HAVEN, CONN.—It has been decided to go ahead with the work of building the electric road between Savin Rock and Merwin's Point, to be finished June 15.

ALBION, N. Y.—A survey has been completed for the proposed elevated single-rail electric road, to be operated by storage batteries between Lake Ontario and Batavia.

THE DOM RAILWAY, of Austin, Tex., reported as purchased and converted into an electric railway, has been bought by the Fort Wayne Electric Company, Fort Wayne, Ind.

PITTSTON, PA.—The Real Estate Trust Company, of Philadelphia, Pa., has placed on record a mortgage against the Pittston Street Car Company for $200,000. The money is to be used to equip the road with electricity.

CLAYTON, MO.—The Clayton and Creve Coeur Railway Company has applied to the County Court for a franchise to construct and operate an electric railway line from Clayton to Creve Coeur Lake.

PITTSFIELD, MASS.—A committee of residents of Lanesboro will consult with the officials of the Pittsfield Electric Railway Company in the matter of extending their lines to Lanesboro, about five miles distant.

THOMPSONVILLE, CONN.—The matter of an electric road from Thompsonville to Springfield is being discussed, and the Hartford "Courant" is authority for the statement that definite steps will ere long be taken.

RICHMOND, VA.—The Virginia Electric and Railway Company has applied for permission to construct a double-track elevated railway on Broad street, and the matter has been referred to the committee on streets.

BURLINGTON, VT.—The directors of the Burlington and Winooski Street Railway Company will increase their capital stock by $200,000, and they will extend their lines this spring either to Queen City Park or to the Lake front.

NEW HAVEN, CONN.—The New Haven and Westville Railroad Company has applied for permission to equip with electricity for a trolley system; also for extensions to the line and double tracks throughout nearly the entire route.

KANSAS CITY, KAN.—The Kansas City, Rosedale and Merriam Park Electric Railway Company has petitioned the County Board for a franchise for an electric line on the Southern Boulevard, from Rosedale to the Johnson County line.

NEW YORK, N. Y.—The Sherman Park and Westchester County Railway, capital stock $12,000, has been chartered to build and operate a street railway. The directors are Louis Smadbeck, William Fisher and Isidore B. Brooks, of New York.

PITTSBURGH, PA.—The Suburban Rapid Transit Company has applied for a franchise for a route which will include passage over the proposed new 22d street bridge, and the petition for their franchise has been referred to the committee on corporations.

MIDDLETON, CONN.—The Common Council has voted to grant the petition of the Meriden Horse Railway Company to equip its system with the overhead trolley system. A long fight on the part of the opponents of the trolley had been expected.

JAMAICA, L. I., N. Y.—Fred. W. Dunton, president of the Long Island Boynton Bicycle Railroad Company, will present at the next meeting of the Queens and Suffolk counties boards of supervisors a petition for right of way for his proposed bicycle railroad.

MIDDLETOWN, CONN.—Mayor Vinal has vetoed the resolution of the Common Council permitting the local street railway to equip with the trolley system. He claims that the petition is

not sufficiently specific and does not afford proper protection to the city.

PATERSON, N. J.—The Paterson "Call" is authority for the statement that Architect Coleman Gray, of Paterson, has been offered the position of supervising engineer upon a new electric railway, to be built in Rockland County, New York State. He has not yet accepted.

CORTLAND, N. Y.—H. L. Bronson, representing a Scranton syndicate, appeared before the village trustees with a petition for a franchise for an electric street railway, but the meeting adjourned without taking definite action. Mr. Bronson represented Page, Hand & Simpson, of Scranton.

BATAVIA, N. Y.—The Hon. J. W. Holmes has completed surveys for the proposed experimental line of the Beecher single-track railway from Waterport to Lakeside, and the work of construction will begin as soon as a company can be formed, which it is expected will be within a week.

SAN FRANCISCO, CAL.—J. L. Willcutt, manager of the Consolidated Street Railway Company, states that the actual building of the power house is to be done by the Pacific Improvement Company, and that R. P. Schwerin will have the matter in charge. Plans have not yet been completed.

NIAGARA FALLS, N. Y.—The bill incorporating the Niagara River Tramway Company has passed the Senate. The company contemplates a railway on cables stretched over Niagara Falls. George W. Pound, of Lockport, is the originator of the project; N. R. Campbell, of Niagara Falls, is also interested.

WASHINGTON, D. C.—General Catchings, of Mississippi, has introduced into the House a bill to incorporate a company which proposes to build a bicycle elevated electric railway between New York and Washington, to use the Brett system. Hamilton Disston, the Philadelphia saw manufacturer, is one of the promoters.

ROCHESTER, N. Y.—The directors of the Grand View Beach Railroad have let the contract for their proposed power house to William Summerhays, Sons & Co., to cost $30,000. It is the intention of the company to furnish light to Charlotte, Summerville and Windsor Beach, and also along the line of the railway. Work will be begun at once.

POUGHKEEPSIE, N. Y.—It is now stated that immediate steps will be taken to build the proposed electric line of the Poughkeepsie City and Wappinger Falls Railway, which will cost $750,000. The following prominent residents of Poughkeepsie are interested: W. H. Wood, J. W. Hinkley, J. L. Williams, I. DeGroff, C. H. Case, P. H. Troy and John Mylod.

HARRISBURG, PA.—Charters have been issued to the Houtzdale and Suburban Railway Company and to the Philipsburg and Suburban Electric Railway Company, with same officers, and a capital of $100,000 each. The president is A. Markle, of Hazleton, and the directors are John A. Seely, of Brooklyn, N. Y.; Charles A. Bragg, of Philadelphia, Pa.; E. S. Doud and J. Edwin Giles, of Hazleton, Pa.

Personal Notes.

MR. JAMES I. AYER, whose name has been so prominently before the electrical public for some years, has accepted the position of general manager of the Royal Arc Electric Company, with home offices at 143 Liberty street, New York. As superintendent of the great arc lighting plant of the St. Louis Municipal Electric Lighting and Power Company, Mr. Ayer had a field which gave ample opportunities for the display of those qualities which have placed him among the foremost electrical engineers in America. The achievement of Mr. Ayer in planning, constructing and putting in operation this plant, the largest arc lighting installation in the world, within 11 months from the day he took hold of the work, ranks among the great feats in electrical engineering, and implies a prosperous future for the company with which he has connected himself. Mr. Ayer was elected president of the National Electric Light Association in 1892, and presided at the St. Louis meeting in 1893—one of the most successful meetings, particularly from a technical standpoint, in the history of the association, and whose success was largely due to the marked organizing abilities of its president, and the great esteem in which he is personally held by a host of friends and acquaintances.

MR. E. S. FERRY, Fellow in Physics and Electrical Engineering at the Johns Hopkins University, has accepted a position in the engineering department of the Royal Arc Electric Company, New York. Mr. Ferry is well known for his researches on the subject of light, both at Cornell University and Johns Hopkins, and has made important contributions to the literature on the subject. He was formerly an instructor at Cornell.

Trade and Industrial Notes

PROF. E. P. ROBERTS is preparing plans for the electric plant of the Garfield Building, Cleveland, Ohio, in which 2,300 lights will be used.

THE WROUGHT IRON BRIDGE COMPANY, Canton, Ohio, has, during the past few months, been running their works on full time, notwithstanding the so-called stringency.

THE PURITY OIL FILTER MANUFACTURING COMPANY, 90 Water street, Pittsburgh, Pa., finds business excellent thus far in April. It has duplicated orders sold from one to two years ago four different times in ten days, showing that "the proof of the pudding is in the eating."

FRANK H. STEWART, 7208 Green street, Philadelphia, has removed to 41 North Seventh street. He reports having recently received an order for 225 15-ampere flush switches for one building in Philadelphia, and a number of orders for ceiling fans.

MR. D. C. SPRUANCE, late of the Helios Electrical Company of Philadelphia, has opened an office in the Betz Building, this city, and will devote his attention for the next few weeks to the organization of two electrical manufacturing companies, both of which will be located in Philadelphia.

THE VARLEY DUPLEX MAGNET COMPANY, 64 Cortlandt street, New York, has issued a catalogue calling attention to the merits of the duplex magnet, and including a price list with reference to cuts, showing plainly the dimensions of the various magnets kept in stock by the company.

THE VEGETABLE BOILER COMPOUND COMPANY, of Utica, N. Y., which, as implied by the name, manufactures a compound for the cleansing of boilers, is in receipt of many flattering testimonials, in which the writers state that the compound accomplishes even more than the manufacturers claim.

THE DAYTON (OHIO) GLOBE IRON WORKS COMPANY has issued a 106-page catalogue of power transmitting machinery, including gearing, shafting, pulleys, couplings, hangers, boxes, floor stands, collars, etc. A number of pages at the end are devoted to tables useful to mechanical engineers and millwrights.

MARK A. RIPLOGLE, Cedar Falls, Iowa, has issued a catalogue of governors for water wheels operating electrical machinery. By means of these governors it is claimed that the speed of a water power shaft can be regulated almost as closely as that of a steam engine shaft, and the practical results are just as good.

T. T. BURCHFIELD & CO., Philadelphia agents for M. A. Green engines, are putting up for the Ringing Rock Electric Railway Company, Pottstown, Pa., two 150-h. p. 15 by 14 inch direct connected engines with two 72 by 18 foot high pressure boilers, installed complete with pumps, heaters, injectors, etc., to be in running order by May 10.

THE UNITED COLUMBIAN ELECTRIC COMPANY, 280 Broadway, New York, has issued a catalogue describing in detail its improved twin series railway motor, and it will repay those interested in electric street railways to send for a copy. The explanations are clear, the engravings good and a table of comparative tests printed is very suggestive.

THE INTERIOR CONDUIT AND INSULATION COMPANY, 44 Broad street, New York, informs us that the Government architects, after thorough tests of its new iron armored conduit, have signified their approval of it, and have already taken measures to have Government buildings now in the process of construction entirely equipped with the iron armored conduit.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., has received an order from the Delaware, Lackawanna and Western Railroad Company for two engine house roofs, both roofs to be covered with the Berlin Iron Bridge Company's patent anti-condensation corrugated iron. Also an order for an iron fireproof building for the laundry, kitchen, engine and boiler rooms of the Green Island Improvement Company's new hotel at Lake George, N. Y.

THE SUNBEAM LAMP MANUFACTURING COMPANY, 703 La Salle street, Chicago, has issued two circulars, which users of incandescent lamps would do well to send for. They contain a discussion of the points which affect the economical use of incandescent lamps, a table of some tests of lamps in actual service in Chicago, showing how inefficient lamps may be, and tables giving full electrical data of the various Sunbeam lamps manufactured.

THE E. W. BLISS COMPANY, 17 Adams street, Brooklyn, N. Y., are completing two large presses for shipment. One is a toggle drawing press weighing 140,000 pounds and driven by an engine attached to it. This press was ordered from England, and is to be used in drawing up heavy steel shells. Another press, for one of the largest tin stamping firms in this country, weighs 75,000 pounds, and will be used for drawing up heavy enameled iron ware of various descriptions.

THE HOPPES MANUFACTURING COMPANY, Springfield, Ohio, manufacturer of the well known "Hoppes" live steam feed-water purifier, has secured the contract for the purifiers for the new city electric light plant now being erected by the Public Light-

ing Commission of Detroit, Mich. The Hoppes purifiers were selected after very strong competition. The order calls for seven 200-h. p. purifiers to carry 165 pounds of steam working pressure. Each purifier is required to heat and purify 9,000 pounds of boiler feed-water per hour.

A. L. IDE & SON, of Springfield, Ill., report the following recent sales of Ideal engines to electrical companies: One 12 by 12 to the Franklin Electric Company, Franklin, Mo.; one 15 by 14 to the Monett Electric Company, Monett, Mo.; one 13 by 12 to the Chicago Edison Company, prepared for direct connection to an Edison armature for the Gottfreidt Brewing Company; one 6 by 6 to the Great Western Manufacturing Company, for Leadville, Col.; one 13 and 20 by 14 to the Western Electric Company, for Rutland, Vt., and two 8 by 10 to the Peninsular Electric Company, for Wayne, Mich.

CUSHING & MORSE, 225 Dearborn street, Chicago, are sending out an envelope, the addressed face of which is in itself a clever conception, enclosing several pieces of sticking plaster. On one flap of the envelope is printed "stick to us and we will stick to you," and on the other the following directions: "For faulty circuits, first cleanse the lines by removing all the old imperfect stuff, and substitute Kerite insulated wire. For leaky joints discard everything else and wrap with Kerite tape. To cure profanity use plenty of Kerite. To make a success of any electrical installation use Kerite. For cuts or bruises use enclosed plaster."

J. L. HAYES & CO., manufacturers of switches and tablet boards, Pittsburgh, report business exceedingly good. Among some of the recent orders received are the following: 125 fuse boxes for the new Postal Building, New York City; 106 tablets for the Carnegie Steel Company's new building on Fifth avenue, Pittsburgh; 2 switchboards, 4 by 5 feet, for the McIntosh & Verner Building, Pittburgh; 1 switchboard, 7 by 4 feet, for the Second National Bank, Pittsburgh; a switchboard 5 feet square for the Morris & Cass Paper Company; 8 marble tablet tables, with 8 main line switches—16 switches in all—for the Huron Building, Pittsburgh.

MESSRS. FORD & BACON, late of the La Roche Electrical Works, of Philadelphia, have opened an office in the Philadelphia Bank Building, were they will conduct business as consulting and electrical engineers. These gentlemen are so well and favorably known to the electrical fraternity through former important positions held by both, that this introduction is scarcely necessary. Mr. Ford was formerly the Chicago representative of the Short Electric Company, and Mr. Bacon was connected with the Wightman Electric Company, of Scranton, Pa., for some time. Messrs. Ford & Bacon are thoroughly capable and reliable gentlemen, and any business entrusted to them will receive the very best attention.

STANLEY & PATTERSON, 32-34 Frankfort street, New York, have issued an attractive catalogue of the general electrical furnishings and supplies which they handle. This list is a very large one, including numerous styles of annunciators, alarms, bells, buzzers, switches, push buttons, electric bell pulls, gas lighting supplies, battery motors, small dynamos, primary batteries, miniature incandescent lamps, medical apparatus, electric door openers, telegraph instruments, insulated wires and cables, cut-outs, lamp shades, light fixtures, magneto and electrical telephones, etc. This company is agent for the well known "Paranite" wires and cables. They are making a specialty of telephones and telephone supplies, and have on the market a magneto transmitter that is claimed to be one of the best in the market to-day. The catalogue is conveniently arranged and carefully indexed, and gives some idea of the scope of the company's business. Stanley & Patterson have had extended experience in the electrical field, and are meeting with well merited success.

THE PETTINGELL ANDREWS COMPANY, of Boston, Mass., an electrical supply establishment whose name is familiar throughout the country, and particularly in New England, entered upon the sixth year of its existence last month. During this period the company has earned the confidence of the electrical fraternity generally as the result of well directed energy and discreet business sagacity. It was the first electrical supply house started in New England, and has grown with the industry. It has recently decided to enter the railway field more actively, to which it has not heretofore given particular attention, and a special department has been created for this purpose. It will also, on or about May 1, remove into very handsome new quarters, more centrally located in the building at the corner of Federal and Franklin streets, directly in front of where it originally started in business. A better location is hardly to be found in the city of Boston, or a building more admirably adapted to the conduct of its business, bordering, as it does,on three streets—Federal, Franklin and Channing—thus giving to it abundance of light and magnificent sign display privileges. In its new home it will have four separate departments of business—the lighting supply, the railway supply, the motor and the telephone and telegraph. Beside these there will be a department for retailing small supplies. At present the company is the sole New England agency for the Okonite Company, Interior Conduit and Insulation Company, Bryant Electric Company's switches, sockets and cut-outs, Standard Paint Company's P. & B. compound and paints, P. A. line and feeder wires, O. K. line and feeder wires, P. A. incandescent lamps and the Medbury insulation for railway construction.

Business Notices.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

OPEN AND CLOSED CIRCUIT CELLS.—The Hayden carbon Porous cup No. 1 cell; the Hayden carbon porous cup No. 2 cell; a Leclanche clay porous cup cell; a standard Fuller cell; a No. 2 Fuller cell; a single cylinder carbon cell; a double cylinder carbon cell. All reliable and efficient and at prices lower than ever. THE HAYDEN-BOOKER MFG. CO., 2140 DeKalb St., St. Louis, Mo.

Illustrated Record of Electrical Patents.

U. S. PATENTS ISSUED APRIL 3, 1894.

(In charge of W. A. Rosenbaum, 177 Times Building, New York.)

517,427. PROCESS OF MANUFACTURING ACTIVE MATERIAL FOR SECONDARY ELECTRIC BATTERIES; W. H. Boese, Berlin, Germany. Application filed June 27, 1893. This consists in mixing a metallic oxide with a sulphonic acid of anthracene and simultaneously removing electrolytically soluble compounds.

517,432. INCANDESCENT LAMP; A. C. Carey, Lake Pleasant, Mass. Application filed Feb. 3, 1894. An incandescent lamp having a butt of moldable, electrically non-conductive material, shaped to fit any socket, having external longitudinal grooves, contact pieces molded in its end, and leading-in wires connected with the contact pieces and laid in the grooves.

517,450. ELECTRIC BURGLAR ALARM; J. Frame and R. B. Morden, Cooper, Iowa. Application filed Dec. 26, 1893. This comprises a magnet controlling a release key to a clockwork mechanism for a mechanically operated alarm.

517,452. INSULATING COMPOUND; A. Gentzsch, Vienna, Austria-Hungary. Application filed Oct. 7, 1893. This consists of the extract from fossil resins from which the gas, vapors and oils have been removed.

517,455. SECONDARY CELL OR BATTERY; G. B. Henry, Hartford, Conn. Application filed June 21, 1893. The combination of plates with their terminals, and an electrolyte composed of a spongy mass of flax seed mixed with dilute sulphuric acid.

517,480. ELECTRIC SYNCHRONIZER FOR CLOCKS; H. S. Prentiss, Elizabeth, N. J. Application filed Nov. 3, 1892. A timepiece provided with a detent, a train and a cam mounted on one of the arbors of the train and engaging the lever to permit of its being actuated at the hour indicated by the timepiece.

517,498. ELECTRIC TRAIN LIGHTING AND BRAKING SYSTEM; G. W. Swartz, Florence, Ala. Application filed Sept. 1, 1893. The combination with the brake magnets and their armature, of a rod connected with the armature, and screw threaded nuts on the threaded portion above and below the armature, brake shoes pivotally connected with the rod, and links suspending the brake shoes from the frame of the truck.

517,502. CIRCUIT MAKER; J. Weaver, Canandaigua, N. Y. Application filed Sept. 30, 1893. This comprises a horseshoe-shaped bracket, circuit wires secured thereto, a contact piece, a horseshoe-shaped arch and a fusible strip secured to the arch at one end, its opposite end adapted to hold the contact strip normally out of contact.

517,520. MINER'S SAFETY LAMP; J. Graham and H. Chapman, Morley, England. Application filed Oct. 7, 1893. The combination of a burner, electric lighting means arranged adjacent thereto, the chambers carried by the lamp and the contact piece extending into the same.

517,531. INDUCTION ELECTRIC RAILWAY; C. E. Roehl, St. Joseph, Mo. Application filed May 4, 1893. The combination of primary coils located along the roadway, secondary coils carried by the moving vehicles and self-inductive resistances in series with the primary coils. (See illustration.)

517,547. BURGLAR ALARM SPRING; M. T. Gordon, Stapleton, N. Y. Application filed Dec. 12, 1893. This comprises a base plate and a contact plate secured thereto, but insulated therefrom, levers and springs co-operating therewith, means for limiting the outward movement of the levers, and means whereby the base plate and contact plate may be connected with electric conductors.

517,549. CONDUIT ELECTRIC RAILWAY; W. C. Keithly, San Francisco, Cal. Application filed Sept. 17, 1892. The combination of an underground conduit, a wire, a flanger hanger trol-

ley arm, a spring, and means for raising or lowering the trolley arm.

517,564. MICROPHONE; W. Deckert, Vienna, Austria-Hungary. Application filed March 1, 1893. The combination with a casing and cover, a mouthpiece, a diaphragm having a protecting coating against moisture on the side facing the mouthpiece, and an electrode. (See illustration.)

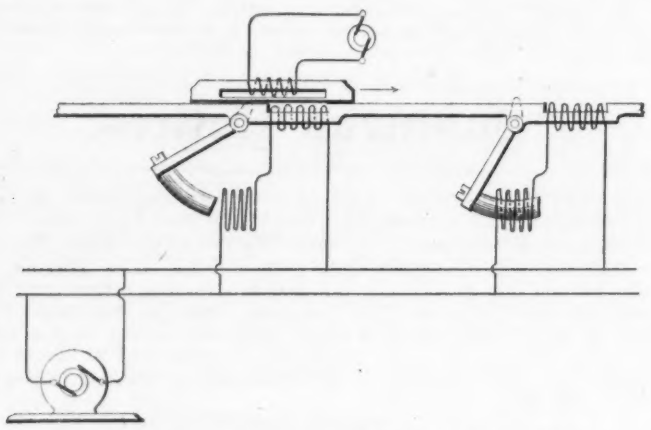
517,582. ELECTRIC SWITCH; R. Mackie, New York, N. Y. Application filed Aug. 7, 1893. This comprises a contact bar provided with a spring to return it to its starting point, in combination with an independent mechanical spring clutch for holding the bar at its final contact, and means for releasing the clutch actuated by shutting off the current.

517,591. INSULATING TUBE; M. Robinson, Newton, Mass. Application filed Jan. 6, 1894. A tube provided with longitudinal ridges throughout the entire length of the body of the tube.

517,621. INSULATOR; L. McCarthy, Boston, Mass. Application filed July 15, 1893. This comprises a case, metallic portions placed therein and separated from each other by an interposed layer of insulating material, an inwardly extending flange, a series of sheets of mica outside the flange on one of the insulated metallic portions and in contact around the metallic portion with the insulating material within the case, and a washer on the insulated metallic portion.

517.634. PIN FOR INSULATORS; G. H. Winslow, Pittsburgh, Pa. Application filed Oct. 25, 1893. The combination of an insulator provided with a threaded socket, and a reinforced pin threaded at one end for engagement with the insulator and so mounted on its support as to be capable of rotation. (See illustration.)

517,664. ELECTRICAL SWITCH; E. Ruebel, St. Louis, Mo. Application filed Sept , 1893. This comprises a swinging arm pivotally mounted upon an insulated support, the arm being adapted to break the circuit when in its inoperative position and when raised to make contact with the terminal of an electrode.



No. 517,531.—INDUCTION ELECTRIC RAILWAY.

517,668. ELECTRIC MOTOR; W. J. Still, Toronto, Canada. Application filed March 3, 1893. The combination with the magnets, armatures and commutator formed of metallic sections and insulating partition between the sections, of brushes insulated from the holder by insulating plates.

517,669. ELECTRIC MOTOR; W. J. Still, Toronto, Canada. Application filed March 3, 1893. The combination with the field magnets having curved ends and the armature revolving between the curved ends, of curved plates carried by the curved ends of the revolving armature.

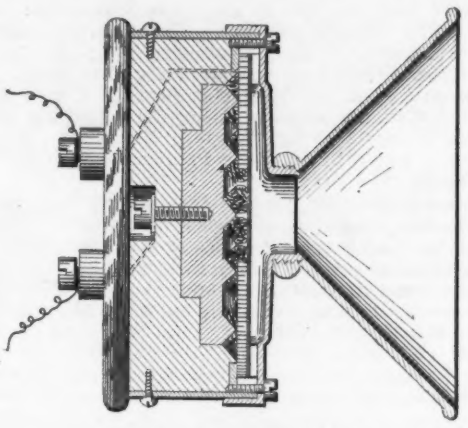
517,692. CONDUIT ELECTRIC RAILWAY; H. A. Goreham, Decatur, Ill. Application filed Aug. 14, 1893. This comprises a conduit having a central rib or upward extension therein supporting and insulated from the trolley wire, slotted grates covering the conduit and communicating with a trench below the conduit, and valves in the lower surfaces of the conduit.

517,714. GOVERNOR FOR ELECTRIC MOTORS; J. F. Winter, Baltimore, Md. Application filed Sept. 21, 1893. This comprises a closed dustproof box, a shaft therein projecting outside, two sets of stationary contacts within the box and insulated where they pass through the walls of the box, and each set arranged in a part circle concentric with the shaft, and a shunt lever in the box and mounted on the shaft.

517,734. FEEDING MECHANISM FOR MAGNETIC SEPARATORS; G. Conkling, Glens Falls, N. Y. Application filed June 25, 1891. This comprises moving belts mounted one above the other, mechanism for operating the same, a chute conveying ore from one belt to the other and a fan blower adapted to deliver air into the chute whereby the velocity of the ore is increased.

517,743. ELECTRICALLY OPERATED RAILWAY SWITCH; W. S. Gavey, Brooklyn, N. Y. Application filed April 1, 1893. This comprises a swinging switch rail, electromagnets arranged to swing the same, shunt wires for each switch, the wires being in connection with the switch magnets and in different vertical planes, an overhead trolley, and contact carried by the cars to engage therewith, and contact pulleys adapted to contact with different shunt wires.

517,762. TELEPHONE; S. D. McKelvey, Canton, Ohio. Application filed Feb. 20, 1893. This comprises a transmitter, a vibratory structure to which the transmitter box is rigidly attached, the structure being of such character that the speaker may support his body upon and against the same, and a suitable receiver.



No. 517,564.—MICROPHONE.

517,763. MAGNETO TELEPHONE; S. D. McKelvey, Canton, Ohio. Application filed Sept. 13, 1893. A receiver having a shell formed in two equal and similar parts, which are united by a screw cap, and a handle engaging with the ends of the shell.

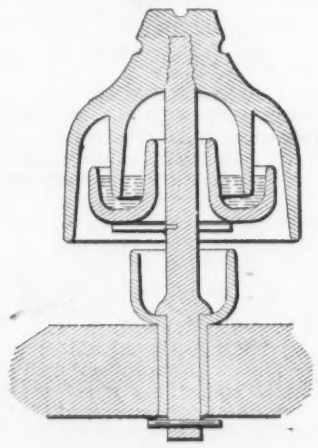
517,764. MAGNETO TELEPHONE; S. D. McKelvey, Canton, Ohio. Application filed Dec. 6, 1893. This comprises a diaphragm and a rigid arm pivotally connected thereto at one end and having its other end provided with divergent points, which are attached to the diaphragm in or between different nodal circles.

517,767. AMAGAMATOR; N. L. Raber, Corvallis, Ore. Application filed April 8, 1893. The combination in an amalgamator of the mercury trough or cup, the tube or cell therein and the lead in the cell.

517,770. RHEOSTAT; A. J. Shaw, Muskegon, Mich. Application filed Oct. 12, 1893. A resistance body consisting of a folded metallic tape having a layer of enamel interposed between the folds and serving both to insulate and mechanically to bind together the several folds or layers.

517,773. ELECTRIC SWITCH; C. F. Speed, E. W. Barker and C. P. Frank, Duluth, Minn. Application filed Dec. 1, 1893. The combination of a feed pole, two movable contact arms connected therewith, contact poles placed in proximity to the arms, an operating shaft, a sector mounted on the shaft and adapted to cause the engagement of the arms with the contact poles together or separately.

517,804. CONDUIT ELECTRIC RAILWAY; W. F. Jenkins, Richmond, Va. Application filed Aug. 10, 1892. The combination with a conduit of two horizontally projecting arms covered with insulation and bent to form depressions, the two conducting wires loosely laid therein, and a trolley having two terminal hooks at its lower end resting beneath the conducting wires.



No. 517,634.—PIN FOR INSULATION.

517,812. SYSTEM FOR CONTROLLING ELECTRIC LIGHTS; W. F. Bradner, Denver, Col. Application filed May 12, 1893. The combination of a rotating ratchet composed of an insulating disc and two conducting plates applied to its opposite faces, the plates having lips bent to engage the teeth of the disc, the lips of each plate engaging every alternate tooth, and four contact brushes, two of which are continuously in engagement with the respective face plates of the disc, while the other two alternately engage the lips of the respective plates as the ratchet is actuated.